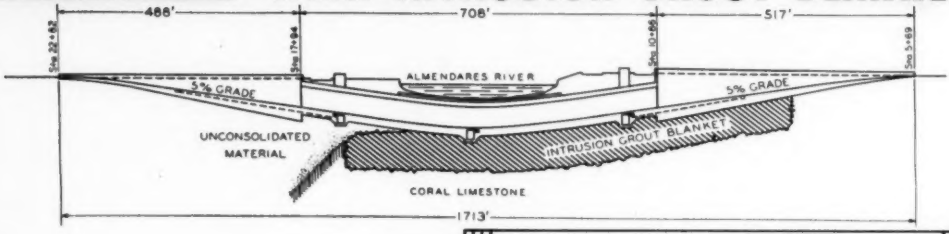
ACI News Letter

Vol. 25, No. 4 JOURNAL of the AMERICAN CONCRETE INSTITUTE December 1953

Highly permeable coral limestone under new Havana tunnel presented costly problem of water control for open cofferdam — so...

PREPAKT SEALS POROUS FOUNDATION WITH INTRUSION GROUT BLANKET



Prepakt's engineering and versatile materials produced a simplified, low-cost solution for water control during construction of the Almendares Vehicular Tunnel, Havana, Cuba. Normal pumping of the open cofferdam in this case would have been difficult and of prohibitive cost.

The porous coral limestone foundation for this twin-barrel, reinforced concrete tunnel was solidified by pumping with INTRUSION grout. This treatment resulted in a horizontal grout blanket 20 to 25 feet thick which effectively sealed the bedrock against water inflow. Some 166,000 sacks of INTRUSION cementing materials were pumped into an estimated 67,000 cubic yards of coral limestone.

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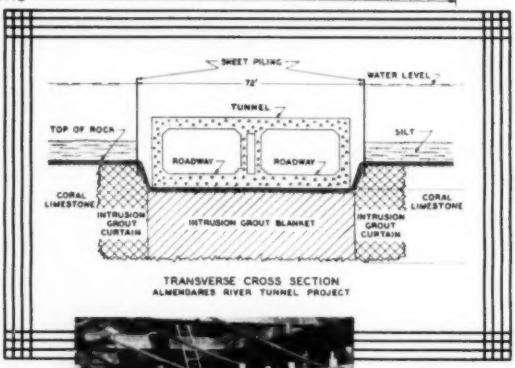
The extra strength and high penetrability of INTRUSION grout made this Intrusion-Prepakt project highly successful —saving time, trouble and money.

Drilling and grouting were performed under subcontract to Raymond Concrete Pile Co.



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Foundation grade, 38 feet below river surface, stays dry after Intrusion grouting.

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ACI

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On the Cover—Forebay Channel on the Davis dam project on the Colorado river between Arizona and Nevada.
—*Courtesy U. S. Bureau of Reclamation*

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Technical Committee Activities Expanded—Action on Joint Committee Report

The Board of Direction of the Institute at its meeting, Oct. 28, 1953, in conjunction with the Southwest Regional Meeting in Houston, Texas, took a number of actions with regard to technical committee activities which are of interest to ACI members.

Noting that the *Reinforced Concrete Design Handbook* had not been revised since first published in 1939, the reactivation of Committee 317, which was responsible for the original work, was authorized. Mr. Thor Germundsson was appointed chairman of the committee and it is expected that when the members of the committee have been selected and appointed, that work on bringing this widely-used publication up to date will shortly get under way.

After considerable study, the Technical Activities Committee recommended the activation of two new Institute committees dealing with construction problems which were concurred by the Board. The first of these, Committee 331, Structures of Concrete Masonry Units, resulted from the recommendation of the TAC that because of the present extensive use of concrete masonry units, the number of problems connected with their use, and the lack of uniformity in design and construction of masonry structures, it formed a fertile field for study by a technical committee.

This committee under the chairmanship of R. E. Copeland is to develop methods of structural analysis and design, and recommended design and construction practices to provide users of concrete block, brick, and tile with authoritative information and guidance in plain and reinforced concrete masonry.

The second, Committee 332, Recommended Practice for Residential Work, C. O. Christenson, chairman, has a more limited mission at present. It is to explore the feasibility of preparing a recommended practice for use by the small builder

Continued on p. 4

and contractor, and whether or not this can be done in a publication of reasonable length. Therefore, part of the initial job of the committee will be to review the literature now available to determine whether or not it suits the need of the field and to recommend a course of action toward filling any existing need. Members may assist in this work by sending to Institute headquarters, for forwarding to the committee, copies of available literature in this field.

Another important decision reached by the Board of Direction was that on the basis of recommendations of a Joint ACI-ASCE Steering Committee, appointed by the two societies in February, 1953, the *1940 Joint Committee Report of Recommended Practice and Standard Specifications for Concrete and Reinforced Concrete*, should not be continued, revised or rewritten, that additional copies not be printed, and that it be allowed to die out as soon as present available printings are exhausted. Similar action by the other societies collaborating in the report is being invited.

A number of problems incident to the withdrawal of the *Joint Committee Report* are now being studied by the joint steering committee. Since this action will leave ACI Committee 318, Standard Building Code, alone in the field of design practices for reinforced concrete, it may necessitate the expansion of the makeup and powers of this already important ACI committee. Points under consideration by the steering committee are a study of the remaining material in the *Joint Committee Report* not having to do with design, correlation of research, and reporting thereof to ACI Committee 318 so that consideration for incorporation into the Building Code may be given, and means by which latest theories may be disseminated to designing engineers in advance of their incorporation into the Building Code.

These Board actions cover a broad range of Institute member interests and forecast the emergence of new ACI publications in segments of the field not now covered as adequately as might be. While committee action necessarily takes time, the ground work has been laid for important developments of value to the ultimate user of concrete and its products with the end result being an increase in service to the profession by the American Concrete Institute.

Heads American Concrete Institute staff

William A. Maples was named Secretary-Treasurer of the American Concrete Institute at a meeting of the Board of Direction in Houston, Texas, Oct. 28, 1953. Mr. Maples has been a member of the staff of the Institute for the past five years as associate and managing editor of the ACI JOURNAL, and latterly as acting secretary-treasurer.

Mr. Maples is a 1932 chemical engineering graduate of Michigan State College whose experience prior to joining the Institute staff included work in the laboratories of the Ford Motor Co., Department of Public Works, City of Dearborn, and 20 months during World War II in the Publications Department, Engineer School, Ft. Belvoir, Va. The latter organization produced the technical literature used in the training and operations of engineer units throughout the Army.

Mr. Maples is a member of Tau Beta Pi, national honorary engineering society, the Society of American Military Engineers, the Assn. for the Advancement of Science, and the United States Army Reserve in which he is a Lieutenant Colonel, Corps of Engineers.

Reviewers needed

Revista del Colegio de Ingenieros de Venezuela

This Venezuelan technical periodical is now being received regularly at Institute headquarters. A volunteer reviewer is needed to keep Members informed of pertinent papers in this publication through the "Current Reviews" section of the JOURNAL. Those interested please write the Secretary.

Gradbeni Vestnik

This Yugoslavian technical periodical is now being received regularly at Institute headquarters. A volunteer reviewer is needed to keep Members informed of pertinent papers in this publication through the "Current Reviews" section of the JOURNAL. Those interested please write the Secretary.

Southwest engineers focus spotlight on lightweight structural concrete and prestressing at Houston regional meeting

New developments—corrugated box forms, lightweight prestressed concrete, lift slabs—point way to construction economies

With more than 335 engineers and technicians attending from all points of the nation, ACI's Sixth Regional Meeting, Rice Hotel, Houston, Texas, October 29-30, emphasized developments in concrete construction being used in the Southwest, particularly lightweight structural concrete and prestressing. Laboratory investigations and construction practices reported during the two-day meeting pointed to the possibilities offered by combining lightweight concrete with prestressing. Use of lightweight precast concrete members with cast-in-place construction also received attention.

Techniques pointing to construction economies—corrugated box forms, lift-slab construction, prestressed cylindrical piling, and precasting—were other topics highlighted on the program.

Other phases of concrete engineering that were discussed included expressways, anchor bolts, pipeway stanchions in chemical plants, bar spacing, and an intriguing story about a sunken concrete ship that is now providing information on the resistance of expanded shale concrete to sea water.

Concrete expressways

Frank W. Chappell, consulting engineer, Dallas, served as chairman of the opening session.

All pavements constructed in the Houston expressway system have been of concrete on a flexible base course, reported W. J. Van London, engineer-manager, Houston Urban Expressways, Texas Highway Department, in his paper "Concrete in Urban Expressways of Houston." Structural concrete for overpass structures has also proved itself, particularly from the cost standpoint, he noted.

Houston has about 35 miles of freeway system scheduled for development. About 10 miles of freeway have been completed; in addition, the state of Texas has designated an additional 75 miles for ultimate freeway development, and the city and county have requested another addition of 130 miles, making a total of about 240 miles of freeway type traffic arteries being considered in Houston's metropolitan area.

The central interchange, which surrounds the central business area, will provide access to and interchange with all freeways in the system, and will be composed of about 10 miles of structures overpassing 44 railroad tracks and about the same number of major streets.

In general, the expressways consist of six freeway lanes, three in each direction, separated by a median as wide as right-of-way considerations will permit, with 10-ft surfaced shoulders on each side and 24- to 32-ft frontage roads on each side of the freeway lane. In most cases, said Mr. Van London, overpass structures are used at railroads and street crossings because of inability to obtain gravity drainage for underpasses. These structures are 86 ft wide to provide six 12-ft traffic lanes, a 4-ft median divider, and 4 ft for clearance and a railing on each side. In the future, he noted, separate structures for opposing traffic lanes, with rails on both sides, will be constructed as far apart as available rights-of-way will permit.

All pavements constructed have been of concrete on a flexible base course. The present design for a 20,000-lb wheel load is a 6-in. base course of cement stabilized sand and shell with a compressive strength of about 600 psi, and a 10-in. concrete pavement reinforced with 46 lb of wire mesh per sq yd. Where curbs are not used, as on the outside

of the freeway lanes, the pavement is thickened to 11 in. at the edge, tapering to 10 in. 6 ft from the edge. Contraction joints only are used on 15-ft centers. These are formed with corrugated, galvanized 28-gage metal having seven corrugations with ½-in. radius. The corrugations formed in the slab ends, Mr. Van London said, are considered in a measure as a means of transferring traffic loads from one slab to another.

Design and control of concrete mixtures for the pavement follows, for the most part, standard Texas Highway Department practice. The specification calls for a minimum 7-day flexural strength of 650 psi, a minimum cement content of 4½ bags per cu yd of concrete, a maximum water-cement ratio of 7½ gal. per sack, a maximum coarse aggregate factor of 0.85, and a workable mix. The contractor, Mr. Van London said, may vary the mix within these limits to secure the most economical mix that will attain the specified strength.

All mixes must be designed according to the provisions of Texas Highway Department Construction Bulletin No. C-11. Mr. Van London said that this provides for absolute volume design, checked by "pilot" tests made immediately prior to construction using the contractor's equipment and stockpiles. These are full-scale tests using the materials and equipment actually to be used in construction rather than material samples and laboratory equipment. Twenty beams are made for each of several designs at varying water-cement ratios and the average strength for each set of 20 beams plotted against water-cement ratio. The contractor may choose any of these designs or an interpolated design that attains the minimum strength in the pilot tests.

During construction, a set of two beams is made for each 500 sq yd of pavement, job cured for 24 hr, then water cured, and tested at 7 days. In the event that the average strength of the last ten beams made on a project falls as much as 4 percent below the minimum specified, said Mr. Van London, the contractor is required to change the batch design accordingly, using the pilot tests as a guide.

Test beams are 6 x 6 x 20 in., generally made in hinged wood molds, and are tested by center-point loading on the job. In addition to beam tests of the concrete, aggregates are also tested to determine grading, specific gravity, unit weight, organic content, and moisture content. This assures uniformity of aggregates and a close control of water-cement ratio, noted Mr. Van London. The field laboratory technician also checks the accuracy of the contractor's batching equipment and oversees batching operations. Each batch leaving the plant is accompanied by an inspection ticket showing, among other things, the amount of water to be added at the mixer and time of batching.

A careful study of compressive strength of test cylinders and cores taken from the pavement and flexural strength of beams made during construction show, said Mr. Van London, an average compressive strength of 4500 psi, and an average flexural strength of 880 psi at 30 days. Test results of cores taken at later dates indicate corresponding strengths of 5800 and 950 psi at about four years.

To check the performance of pavements, periodic condition surveys have been made and results correlated with the Maryland Road Test, Mr. Van London said. The last survey made in December, 1952, of 116,000 sq yd of pavement which had been in service 4.2 years showed an average of 0.78 lineal ft of all kinds of cracks for 100 sq yd of pavement. Comparing this intensity of cracking to that found in previous condition surveys and applying a formula developed in the Maryland Road Test, Mr. Van London said that this section of pavement is good for about 80 years without major repairs under present traffic conditions, although increasing traffic loads will probably make repairs necessary sometime before that.

The specifications and control of structural concrete are similar to concrete for pavement, the principal exception being, said Mr. Van London, that the minimum cement factor is 5 bags per cu yd, maximum water-cement ratio of 7 gal. per bag, and maximum coarse aggregate factor of 0.82. Transit mix concrete is permissible, he said, and has been found entirely satisfactory.

In general, the bridge design used in the past, said Mr. Van London, consisted of the bored and under-reamed type of foundation with 30-in. round columns, concrete caps, steel I-beams or plate girders, and con-

Co-chairmen for the Southwest Regional Meeting were Phil M. Ferguson, center, and John A. Murlin, right. Frank W. Chappell, left, was program chairman

crete slabs. The average cost of 1,023,740 sq ft of this type of structure was $6.30 per sq ft, distributed as follows: substructure, $1.57; structural steel girders, $2.78; slab, $1.55; and railings, $0.28.

The average cost of structural steel erected in the foregoing was about 15 cents per lb; however, on another job in which there was 4,000,000 lb of structural steel, the bid price erected was 17½ cents per lb. Designs for a similar structure requiring 3,300,000 lb of steel had been completed and it was decided to include a concrete girder design as an alternate for contractors to bid on, said Mr. Van London. The average price for structural steel was 11.7 cents per lb, but even so the low bid on concrete was $60,000 under the average bid for steel. Including the increased cost for substructure, the concrete girder design was 16 percent less than the steel I-beam design. Mr. Van London estimated that at present it is possible to build the conventional concrete girder structure for a minimum of 10 percent less than the I-beam plate girder type, and in cases where precast girders or precast slabs are practicable, the advantage may reach as much as 20 percent, based on present steel prices.

Anchor bolts

Sophus Thompson, professor of civil engineering, Southern Methodist University, Dallas, reported on the "Shearing Strength of Anchor Bolts Embedded in Concrete." In the makeup of the test specimens, he said, an attempt was made to simulate actual field conditions which would exist when attaching a steel beam to a concrete column. The concrete columns were 12 x 12 in. or 14 x 14 in., reinforced with four ½-in. steel vertical bars and ⅜-in. lateral ties at about 10 in. on center. The connection angles were 5 x 3½ x ¾-in. clip angles welded to each side of the web of a 6-in. wide flange 20-lb steel beam. The holes in the clip angle were drilled and spaced on 5-in. centers. Two deflection gages were attached to the concrete column and the plungers were allowed to rest directly on top of the clip angles at each bolt.

The anchor bolts were placed in the forms by tightening the nut on each side of the forms, thereby leaving one nut embedded in the concrete at the face of the column. The entire projected portion of the anchor bolt was threaded. No special laboratory techniques were employed, stated Professor Thompson, and the results obtained from the tests should be quite typical and applicable to field conditions.

Twenty specimens with concrete strengths varying from 1960 psi to 6200 psi were tested. This group included 14 specimens with ¾-in. bolts, three specimens with ⅞-in. bolts, and three specimens with 1-in. bolts. All bolts were embedded 10 in. in the concrete. Because of the relatively high concrete strengths used in this group, said Professor Thompson, 18 specimens failed in shear and three were concrete failures.

Another group of 15 specimens had concrete strengths ranging from 1150 psi to 3960 psi. All bolts in this group were ⅞ in. in diameter and lengths of embeddment included three at 6 in., nine at 8 in., and three at 10 in. Four specimens failed in shear and 11 were concrete failures. The shear stress in the bolt shank at failure was then plotted against ultimate strength of concrete. Equations were then written, said Professor

Thompson, to represent the permissible shear stress with a factor of safety of 4.5, based on the average ultimate strength as determined by these tests. Equations were also prepared representing a factor of safety of 6, and a factor of safety of 9. To get some idea of deflections to be expected, bolt loadings based on these equations were computed for each of the concrete strength used in the tests.

Professor Thompson reported that if a factor of safety of 4.5 is used, a deflection of about 0.05 in. or less may be expected. If a factor of safety of 6 is used, a deflection of less than 0.04 in. can be expected, while if a factor of 9 is used a deflection of less than 0.03 in. can be expected. He noted that it was not apparent that the length of embedment as used in these tests affected the capacity of the bolts.

Although noting that further investigations are necessary, Professor Thompson felt that a factor of safety of 4.5 seemed to be ample from the standpoint of strength. Using this factor, the expected maximum deflection is approximately 3/64 in., which for many installations Professor Thompson considered satisfactory. He noted that a considerable portion of this deflection is caused by the crushing of the thread which would occur in any bolted connection.

Corrugated board forms

Corrugated board, long used in the container industry, is now being recognized by the concrete industry as a new and promising material for formwork. H. C. Pfannkuche, Portland Cement Assn., Fort Worth, Texas, reported various job applications of this new material in his paper "Corrugated Box Forms for Ribbed Slabs." Corrugated board is a thick, coarse paper board with alternate furrows and ridges to give it strength and elasticity.

Corrugated box forms were first used for ribbed slab construction in a four-story dormitory at Southwest Union College, Keene, Texas, said Mr. Pfannkuche. Each floor covered approximately 10,000 sq ft. The original ribbed slab design called for 12 in. deep and 20 in. wide metal pans, with 5 x 12-in. plus 2½-in. joists at 25 in. on center. Instead of metal pans however, corrugated boxes which were left in place were used. The boxes were 20 in. wide, 48 in. long, and 12 in. deep. They were made from flat sheets of corrugated paper board which were cut to size and creased in the plant and shipped to the job for assembly. Added rigidity was given to the boxes, said Mr. Pfannkuche, by means of stiffening ribs placed about 6 in. on center along the length of the boxes. This gave the boxes sufficient strength to withstand the combined weight of three men.

At the job site, the sheets were set in jigs, stiffening ribs were placed and the whole assembly was stapled together to form the complete boxes. Those surfaces that would be in contact with the concrete were coated with hot paraffin. Later on, the dipping operation at the job site was eliminated and the contact surfaces of the corrugated sheets were paraffin coated at the factory. Mr. Pfannkuche said that it required 1 man-hr to assemble and coat boxes sufficient for 100 sq ft of floor area.

After the soffit boards or pan supports were in place, reported Mr. Pfannkuche, the corrugated box forms were set in place and stapled to the boards with ⅝-in. staples. It required four men about 2½ days to set the boxes for one floor, about 10,000 sq ft, or about 125 sq ft per man-hr. Where necessary, holes for utility lines or slots around the electrical conduits were cut with pocketknives and additional stapling was done as required. When formwork was completed, steel reinforcement was set in the joists and welded wire mesh slab reinforcement was placed over the entire area.

In placing the concrete by buggies, the rigidity of the corrugated boxes made it unnecessary to use trestles to support the runway, said Mr. Pfannkuche. The runways were laid directly over the mesh which served to distribute the load of the buggies to some extent. There were no failures of the corrugated boxes during construction due to runway loads, concrete placing, or vibration.

Mr. Pfannkuche reported that experimental work and additional studies since that project have developed a method for using corrugated box forms which permits them to be removed without difficulty. It appears, he said, that with reasonable care in erection and stripping, it is possible for a contractor to get from one to three re-uses from the corrugated boxes.

No detail of planning was overlooked in making this new Youth Study Center one of the finest of its kind. Reinforced concrete was selected for the building's framing and floors.

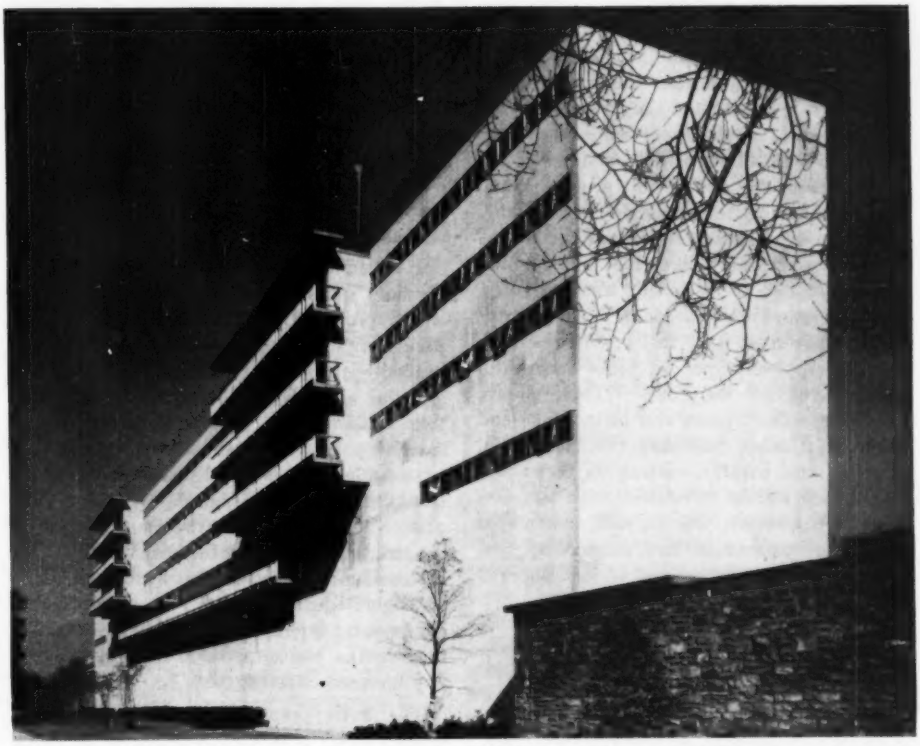
The design includes flat wide beams which span the full width of the building. This framing method permitted a considerable reduction in the total height of the building as compared with conventional deep beams.

Not only did reinforced concrete permit greater flexibility of design, but it also proved *more economical.* Moreover, materials were readily available from local sources.

Reinforced concrete buildings are durable, firesafe, rugged . . . and go *up faster.* On your next job, design for reinforced concrete.

REINFORCED CONCRETE PROVED LESS COSTLY

Youth Study Center, Philadelphia, Pa.
Architects: Carroll, Grisdale & Van Alen
Structural Engineers: Severud-Elstad-Krueger
Contractor: McCloskey & Co.



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More recently, he said, another unique use has been found for these corrugated box forms. A two-story office building at Corpus Christi of about 14,000 sq ft was designed so that the finished first floor was to be about 12 in. above grade, which generally would call for a concrete slab on fill. However, the engineers hesitated to use a slab on fill due to the instability of the underlying material, said Mr. Pfannkuche; hence the floor was designed as a suspended beam and slab construction, utilizing the corrugated box forms. The ground is to be leveled off 6 in. below the under side of the slab and the entire area covered with 6 in. deep by 24 in. wide corrugated box forms. The beams will be cast integral with the slab. With this forming method, reported Mr. Pfannkuche, the designers feel that any difficulty due to the unstable ground can be eliminated. If the ground should shrink, the floor will act as a suspended beam and slab system. If the ground should swell, there would be room for about 6 in. of vertical movement of the ground before any appreciable pressure could be exerted against the under side of the slab.

In discussing costs, Mr. Pfannkuche said that material for 30 in. wide boxes would range from 12.1 to 20.3 cents for 6 to 14 in. deep boxes, and material for 20 in. wide forms would range from 14.1 to 24 cents for 6 to 14 in. deep boxes per sq ft of horizontal area covered by the boxes. These prices, he said, are f.o.b. plant and include one end closure and seven stiffening ribs per 48 in. long box and paraffin coating on those surfaces which will be in contact with the concrete. On a recent job, he said, corrugated boxes were assembled and stapled by two carpenters with a labor cost of just under 2 cents per sq ft of horizontal form area.

Volcanic cinder aggregates

"Experiments on Concrete Made with Volcanic Cinder Aggregates" were reported by Fred J. Benson and Robert M. Gallaway, professor and assistant professor, respectively, civil engineering department, Agricultural and Mechanical College of Texas, College Station, Texas. The volcanic ash aggregate known as Geolite is red in color and chemically consists of about 58 percent SiO_2, 22 percent Al_2O_3, and 10 percent Fe_2O_3, with small amounts of calcium and magnesium oxide.

The first phase of the investigation reported by Professor Benson was concerned with the general concrete-making properties of the aggregate, and with the effect of initial moisture aggregate condition. The second phase was concerned with the effect of grading variations on the strength of concrete made with volcanic cinders, and the third phase was concerned with the use of the material in hollow concrete masonry units.

Professor Benson reported that presoaking the aggregate, as with most lightweight aggregate, promoted increased workability and increased the strength of the resulting concrete mixture for a given water content. It was found that the slump test was of little value in judging the consistency of the mixtures, and it was also found that the cement factor was a better criterion of strength than the water-cement ratio for this particular aggregate. Compressive strengths were affected materially by the grading of the mixture. A series of mixtures was prepared in which 20 percent by weight of the fine aggregate was added to 80 percent of the coarse aggregate. Professor Benson indicated that considerably higher strengths were obtained with the finer grading.

He said that a series of hollow concrete masonry units were then made on a machine which provided vibration but no hydraulic pressure. Mixtures were prepared using coarse aggregate only and mixtures of coarse and fine aggregate. These were prepared at two consistencies, a dry consistency considered proper by the block producer and a considerably wetter consistency which the laboratory work had shown to be desirable. No difficulties were encountered in molding the block at either consistency. He reported that the wetter mixtures compacted to higher densities and had much higher compressive strengths. Use of the additional fines in the block mixtures did not produce any increase in strength.

The units prepared at consistencies wet enough to get good consolidation in the block machines met ASTM requirements for strength, but showed too high a absorption, said Professor Benson. The block, however, satisfied the requirements for non-load-bearing units. The block had a pleasing surface texture and were of a rich red color, which Professor Benson believed might prove useful for architectural treatment.

ACI here and abroad

S. W. Oberg, chief engineer, Humble Oil and Refining Co., Houston, general chairman of the local committee for the regional meeting, presided at the Thursday luncheon. H. E. Bovay, Jr., consulting engineer of Houston, and president of the San Jacinto Chapter, Texas Society of Professional Engineers, welcomed the registrants at the Sixth Regional Meeting to Texas, and reviewed briefly general progress in the use of concrete for various types of structures.

ACI President Henry L. Kennedy then spoke on the work of ACI and its effect on the concrete industry both here and abroad. He noted that the Institute now has more than 6300 members in the United States, Canada, and 65 other countries. In a recent visit to Europe, he found that engineers and technologists thought highly of ACI and found the ACI JOURNAL "invaluable as a basis for design and construction." He then described some of the concrete practices and investigations going on in Italy, France, Switzerland, Germany, Denmark, Sweden, Norway, and England.

While in Italy, Mr. Kennedy was presented with several pieces of so-called 2000-year old concrete placed during the reign of Emperor Caius Caesar Caligula, 12 to 41 A.D. Believed to be the oldest known example of hydraulic concrete, which is capable of "setting up" or hardening under water, the samples were taken from piers which once supported a large wharf in the bay of Pozzuoli, Italy, near Mt. Vesuvius. The piers have been submerged since that time, said Mr. Kennedy.

Prior to the discovery of the wharf, it was believed that the ancients, who normally built such structures of masonry, had not learned how to make hydraulic concrete. According to Italian concrete technologists who presented the samples to Mr. Kennedy, Roman engineers discovered, probably accidentally, that the volcanic ash from Mt. Vesuvius reacted with lime to make a cement that would harden under water. The concrete is not a portland cement concrete as we know it today, he noted, but rather is a combination of lime and pozzolanic materials.

At present the samples are undergoing tests in the Dewey and Almy laboratories at Cambridge, Mass., to determine their resistance to weathering, freezing-thawing action, and other deteriorating forces to which the concrete, having been submerged in a warm climate, has not been subjected. An accurate comparison of strength and durability between this early Roman concrete and the modern product cannot be given, said Mr. Kennedy, because portland cement as we know it today is hardly 100 years old, and air entrainment which greatly improves the durability of modern portland cement concretes is hardly 15 years old. Some cubes were selected from the concrete specimens and subjected to a 48-hr cycle of freezing and thawing. Where a poor quality concrete will ordinarily go 50 to 60 cycles, he reported, at 5 cycles the 2000-year old concrete showed distress and at 7 cycles it was all through.

In Italy he found a fine appreciation of the American Concrete Institute and its publications and a firm desire to learn of United States practices. In Switzerland he also found that concrete technicians were firm adherents of Institute publications.

He noted that Swiss technicians were spending considerable effort working with what they called "zero slump" concrete. He said that the water in the mix is reduced until the resulting concrete has a zero slump, and then it is still further reduced to a point where all workability vanishes. However he says, they are beginning to work more and more with air-entrained concrete using slightly higher water-cement ratios, and getting concrete which gives them compaction in 4 to 5 seconds of vibration instead of 50 to 60 seconds as used with the zero slump

In his luncheon address, ACI President Henry L. Kennedy described some 2000-year old concrete recovered from a submerged Roman wharf in Italy. In the background are Vice-President C. H. Scholer and Past President A. T. Goldbeck

concrete. The resulting homogeneous concrete, he noted, is much easier to place in the field and because of air entrainment gives the desired durability. It has been reported, he said, that Switzerland may decide to rewrite road specifications to 1 and 2-in. slump concrete using 4 percent air.

Reporting on his visit to West Germany, Mr. Kennedy said: "The Germans were high in their praise of the ACI JOURNAL. Like most of the other European countries, they accepted the findings of our extensive research in this country on air-entrained concrete. They are going all out in their research but are working only on problems to which they have been unable to find satisfactory answers from United States literature." He noted that West Germany was also considering rewriting specifications for road construction to call for concrete having a 1 to 2-in. slump and 4 percent air.

In the Scandinavian countries, Mr. Kennedy found that all of the technologists thought highly of the ACI JOURNAL, even though there were two distinct schools of thought concerning the manufacture and placement of concrete. One group favors concrete with a slump of at least 2 in. and the use of an air-entraining agent. The other school of thought is still working with zero slump concrete. He was particularly impressed by one of the plants in Sweden manufacturing prestressed members. The beams being produced were approximately 8 in. x 14 in. x 200 ft long. The wires extended the entire length of the beam and were prestressed before concreting. Inserts were placed along the beam at the required ultimate length of the finished product. The beam was concreted with a rich mix, vibrated, and then hot water was rolled over the section for rapid curing. After this, the wires were cut at the joints, the only bond being the bond of the concrete to the wire. The producer stated that even with the lower wages in Sweden as compared to the United States, it would not be economical to make prestressed units of this size unless they could do it on a multiple basis.

Lightweight structural concrete

The afternoon session on Thursday was devoted to lightweight structural concrete. Phil M. Ferguson, chairman and professor, Department of Civil Engineering, University of Texas, Austin, served as session chairman.

The session opened with John A. Murlin, Texas Concrete Products Co., Dallas, presenting the paper "Design Practice in Lightweight Structural Concrete." He noted that in speaking of lightweight concrete, he was referring to lightweight concrete made of expanded shale or expanded clay.

When a new type of concrete is developed, he said, the first thing that should be known about it is its elastic modulus to develop the familiar design constants of k, n, K, j, etc. Such has not been the case in the development of structural lightweight concrete, Mr. Murlin said. Practice has moved ahead of the laboratory, and consequently the design engineer has had to assume some constants not yet proved by laboratory investigation.

It is apparent, said Mr. Murlin, that the elastic modulus of lightweight concrete is not a straight line function of its 28-day compressive strength, but is a curve which flattens out as it approaches the ultimate. This is also true of all structural material. Elastic modulus used in design for most elastic materials is a tangent modulus taken somewhere in the working stress range before the yield point is reached. It was Mr. Murlin's opinion that such a tangent modulus for expanded clay or expanded shale as produced commercially in the Southwest will show a value in the working stress range considerably higher than 50 percent of $1000 \times f'_c$. This would be particularly true, he said, if the compressive strength is taken not at 28 days, but at 42 or 60 days, since lightweight concrete does not attain its "maturity" at 28 days the way sand and gravel concrete does.

"To justify the use of lightweight concrete, it has to pay its own way," said Mr. Murlin, "by effecting enough economy in the amount of reinforcing steel saved to pay for the additional cost of lightweight concrete and have a significant net savings left over."

Mr. Murlin made no attempt to establish any set rule for determining constants to use in design, but said that each practicing engineer will generally pick his own most economical procedure, depending on local costs of formwork, lightweight aggregate, sand and gravel concrete, and reinforcing steel.

Design factors

J. R. Bissett, associate director, Engineering Experiment Station, University of Arkansas, Fayetteville, reported on research being done to determine design factors for structures of lightweight concrete in the paper "Use of Lightweight Aggregate for Structural Concrete." The aggregate being investigated is expanded shale, produced by crushing the shale and expanding in a rotary kiln at approximately 2000 F. The Rescolite aggregate is produced in three sizes: ⅜ in. to No. 10, No. 4 to No. 30, and fines graded downward from a No. 10 sieve. A mixture of 40 percent coarse material, 20 percent intermediate size, and 40 percent fines was determined as the best mixture, said Mr. Bissett. All concrete mixes were designed by the absolute volume method, and the water-cement ratio and cement factor varied. The water-cement ratio was varied from approximately 4½ to 7½ gal. per sack, and the cement factor varied from 5½ to 7 sacks per cu yd. All of the aggregates were dry at the time of mixing.

The high absorption of these aggregates produced one unusual factor not found in conventional aggregates, reported Mr. Bissett. The 1-hr absorption was approximately 6 percent, and by adding 6 percent water for absorption it was found that good workable concrete could be produced with a low water-cement ratio. By using a water-cement ratio of 4½ or 5 gal. per sack, plus the water that would be absorbed in 1 hr, it was possible, said Mr. Bissett, to mix concrete that would have a slump of approximately 2 to 3 in. The extra water was absorbed within an hour so that by the time the concrete had taken its initial set only 4 or 5 gal. of water were available for hydration of the cement. This mix produced cylinders having a 28-day compressive strength varying from 6000 to 6500 psi, noted Mr. Bissett. He said that the mix having a water-cement ratio of 7 gal. per sack and a cement factor of 6.8 bags per cu yd was chosen as the best mix for further investigations. This mix produced a concrete that had a modulus of rupture of about 590 psi and a 28-day compressive strength of 3880 psi.

These tests indicate, said Mr. Bissett, two principal differences between lightweight concrete produced with this aggregate and hard rock concrete. First, as indicated by diagonal tension failures and the modulus of rupture beams, the tensile strength of this concrete is somewhat lower than conventional concrete. Second, the modulus of elasticity of this lightweight concrete is somewhat lower than that of sand and gravel concrete. He believed that due to the low tensile strength of this concrete, diagonal tension reinforcing should be used where the shearing stresses are greater than about $0.02\ f_c'$. The modulus of elasticity was found to vary from about 0.7 to 0.8 of that of sand and gravel concrete. The n value to be used, said Mr. Bissett, should be 15 where a 3000-lb concrete is used. In determining the elastic deflection, he recommended that an n of about 20 be used.

The Selma story

A ship built in 1919 and sunk in Galveston Bay more than 30 years ago is, in 1953, serving the concrete industry in a unique fashion never contemplated during the ship's lifetime. That was the interesting story unfolded by Ralph B. Rogers, president, Texas Industries, Inc., Dallas, in his paper "The Selma Story."

The Selma, launched in 1919, was the first vessel of its kind, a tanker whose hull was made with reinforced lightweight concrete. After outfitting, the Selma transported crude oil from Tampico to Texas Gulf Coast ports for several years. After three years of service, the ship was struck by a heavy tug which put a large crack in her hull near the bow. She was towed into Galveston for repairs, but since no one could guarantee a method of repairing the crack, the Selma was scrapped. After being stripped of all her equipment, she was towed out into Galveston Bay, the sea cocks were opened, and she was sunk.

Now, 30 years after her death, said Mr. Rogers, the Selma has regained her usefulness to the concrete industry as a means of determining whether expanded shale concrete would successfully withstand the disintegrating effect of sea water and whether it could provide adequate protection against the corrosive action of sea water on reinforcing steel. The investigation began, said Mr. Rogers, when this concrete had been exposed to sea water for 33 years and before the investigation was completed, the concrete had been in sea water for almost 34½ years.

The Selma story is outstanding for several "firsts," said Mr. Rogers. The ship was built in the days before slump was an accepted method of controlling concrete, he said. So one of the engineers, Herbert A. Davis, developed an apparatus for controlling consistency of the concrete placed in the ship's hull. "Our modern slump cone tests for controlling consistency began its development and was first used in connection with the placing of expanded shale lightweight concrete to construct the Selma," said Mr. Rogers.

It was also the first time expanded shale aggregate made in rotary kilns had ever been used for high strength structural concrete. This aggregate, he said, was identical to that which came on the market a few years later and sold under the name of Haydite.

There was still another first involved in the Selma story because the Selma was the largest concrete ship ever built—7500 tons, 434 ft 3 in. long, a beam of 54 ft, and fully loaded, a draft of 26 ft. Her full cargo displacement was 13,000 tons and she had a speed of 10½ knots. Peculiarly enough, noted Mr. Rogers, this part of the ship's history was the least important of the three "firsts" scored on the project.

The design of the Selma called for a hull 5 in. thick on the bottom, and 4 in. thick on the sides. Her construction required 2660 cu yd of concrete reinforced with 1550 tons of smooth reinforcing bars—a fantastic figure of 1165 lb of reinforcing steel per cu yd of concrete. The expanded shale aggregate was supplied in two grades; the fine material all passed a 3/16-in. round hole sieve and the coarse material passed a 9/16-in. round hole sieve with practically all of it being retained on the 3/16-in. sieve. Cylinder tests made at 28 days showed a strength of 5591 psi, noted Mr. Rogers. Today, he said, we would describe the concrete as having an extremely high slump—the average consistency drop was 9 in. To obtain good placement of concrete in the thin hull section in and around the heavy mass of reinforcing steel called for this extremely fluid, easily placed concrete.

"The thorough investigation made of the Selma concrete, and a comparison of its properties today with its properties when the hull was placed 34 years ago, indicates that this particular expanded shale structural concrete has successfully withstood the action of sea water without damage, and has successfully protected the reinforcing steel," emphasized Mr. Rogers.

He said that the concrete is in excellent condition above the water line in the area which was subjected to alternate wetting and drying, as well as in the area below the mean water line. Some of the hull concrete was chipped out to a depth of ¼ in. and at this depth the concrete appeared to be dry, and there was no discoloration from absorbed water. An investigation of the reinforcing steel found it in excellent condition with no pitting of the bars, and the engineers concluded that the slight coating of rust could

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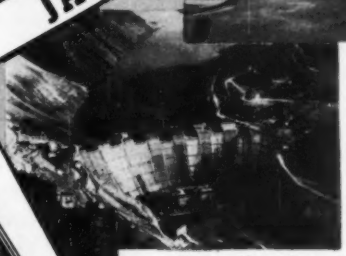

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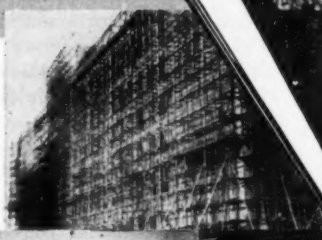
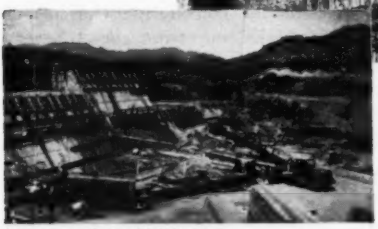


Fuji Bank Bldg., Tokyo, Japan
Economy in this new bank building was realized in initial cost, time and labor, with Protex concrete.



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well have been on the bars when they were placed. Two 2-in. cubes cut from the hull section above the mean water line were found to have an average compressive strength of 10,338 psi which, noted Mr. Rogers, when correlated with 6 x 12-in. cylinders tested at the time of placing the concrete hull would indicate a strength of 8787 psi. Even higher strengths have been indicated by later tests.

Mr. Rogers was of the opinion that expanded clay and shale aggregate concrete placed today should provide the same resistance to sea water and the same protection to reinforcing steel as did the expanded shale lightweight concrete of the old Selma. It is true, he said, that the Selma concrete was mixed with the extremely high cement factor of approximately 11 bags per cu yd; this was at a slump of between 8 and 9 in. Experience has shown, he said, that excellent puddling, placing, and finishing properties can now be obtained with expanded shale lightweight concrete at a slump of from 3 to 4 in. The Selma concrete had an average water-cement ratio of 5.45 gal. per bag. This water-cement ratio, he said, will produce easily placed expanded shale concrete today with a slump of about 3 in. at a cement factor of 6 bags per cu yd. This would be a satisfactory general purpose lightweight structural concrete for use in construction on or near tide water, he said, and should develop a compressive strength of from 3500 to 4000 psi at 28 days, and an ultimate strength of more than 5000 psi.

"It has been demonstrated and generally accepted that the durability of concrete is a function of the water-cement ratio, and within reasonable limits it is a more important consideration than either the slump or cement factor," said Mr. Rogers. "It would therefore seem reasonable to predict that when today's expanded clay and expanded shale structural concrete is exposed to sea water, the same fine performance of the Selma concrete would be the result, provided that a water-cement ratio not to exceed 5.5 gal. per bag is maintained with a cement factor of not less than 6 bags per cu yd."

High strength lightweight concrete

Cedric Willson, chief engineer, Texas Industries, Inc., Dallas, reported briefly on a group of expanded clay and shale concrete mixes which had been designed for high compressive strength—that is, an ultimate strength of 4000 psi or more. He described briefly a few laboratory and job mixes which were designed for and have developed a comparatively high compressive strength. In general, he said, there is no particular problem in developing strength of from 4000 to 6000 psi at 28 days with expanded shale and clay aggregates. This type of lightweight concrete at these strengths has an air dried weight of from 90 to 95 lb per cu ft and is extremely workable and can be placed economically at slumps from 2 to 4 in., he reported.

Concrete in chemical plants

"For simple pipeway installations, there seems to be no reason why lightweight precast concrete stanchions cannot be used with the expectation of economical and maintenance free service," said Archie C. Blackburn, civil design engineer, Dow Chemical Co., Freeport, Texas, in his paper "Concrete Pipeway Stanchions." At present, there are approximately 300 precast, lightweight concrete stanchions or bents in use at the Dow Chemical Co. at Freeport, he said.

The short supplies of structural steel and uncertain delivery dates in 1951 were the primary reasons for considering the use of precast lightweight concrete for pipeway stanchions instead of steel which had been previously used, he said. Costs were approximately the same for either concrete or steel pipeway construction.

Since the precast stanchions were designed for erection on existing foundations prepared to receive structural steel stanchions, it was specified that the concrete should have a maximum weight of 100 lb per cu ft and a minimum compressive strength of 3000 psi at 28 days. Most of the pipeways consisted of twin column bents usually spaced at 20 ft, 6 to 10 ft in width, and 10 to 20 ft high, with two or three horizontal beams for supporting banks of pipe. Some single column T-head stanchions and special four-column braced towers for anchor points and steel truss supports were used as required. The tallest bents used were 32 ft high.

Most of the difficulty with the concrete stanchions, he said, seems to be a result of

Above: Members of the local committee for the Houston meeting are (l. to r.) J. B. Baird, chairman of registration and arrangements; George G. Smith, hospitality chairman; and C. A. Bullen, chairman of technical program committee

Above: Ed C. Jancik, permanent secretary

Left: S. W. Oberg, general chairman of local committee

failure of the concrete in shear, which has been manifested in spalling of beam edges, shearing out of strut anchors, and in one case a complete failure of a beam. The compressive strength of the concrete was generally far above the minimum specified and the concrete was hard and brittle. However, Mr. Blackburn said, the failures do not seem to be due to any weakness in the concrete, but rather to improper construction and/or overloading.

Construction movies

The Thursday evening session under the chairmanship of Walter P. Moore, consulting engineer, Houston, featured one slide presentation and three motion pictures on various phases of concrete construction. The slide presentation, "One Million Gallon Prestressed Elevated Water Tank," by Jean H. Knox, district manager, The Preload Co., Inc., Dallas, described construction of the prestressed concrete tanks erected at Camp Bowie, Texas. In addition to being used as water tanks, Mr. Knox called attention to the versatility of prestressed concrete tanks by noting that they had been used successfully for storage of petroleum products in above ground or below ground installations and have also been used for storage of liquified industrial gases at temperatures below −300 F and for storage and process tanks with liquids above 150 F.

George P. Rackle, The George P. Rackle & Sons Co., Houston, presented the movie "Economy Obtained by the Use of a Precast Prestressed Concrete Structural System." He pointed out that factory line production combined with simplicity of design of the basic structural units makes it possible to provide a reinforced concrete structure for the same or less cost as a building of semi-fireproof construction. He emphasized three points that make such a system possible: (1) simplicity of design of members—production problems must be kept in mind when designing precast units; (2) straight-line production flow at the precast concrete factory; and (3) use of proper equipment and trained personnel for the installation of the system.

"Design is governed by both manufacturing requirements and structural properties," Mr. Rackle pointed out. "This almost automatically results in simplicity, which in turn is a hallmark of good design. It is not enough, however, to design merely for efficiency and economy in manufacture; economy of installation is equally important."

Field research in construction economy, he said, has led his company to standardize on a bay size of 20 x 40 ft, and all of the structural units currently being manufactured fit within this module. Structural members illustrated were a combination of precast and prestressed units, manufactured of lightweight expanded shale or clay aggregate concrete.

This "package" included prestressed beams or girders, precast channel units, and precast columns. Other members not yet standardized are T-section pilasters, wall slabs, and joists.

The motion picture "Prestressed Concrete Cylinder Piling Being Used for Offshore Work in the Gulf Coast Region" was introduced by H. B. Miller, district manager, Raymond Concrete Pile Co., Houston; the movie illustrated the fabrication and manufacture of these units. The hollow cylindrical prestressed concrete piles, available in standard outside diameters of 36 and 54 in., are reinforced in a conventional manner and centrifugally cast by the spinning method. These cylinders of 16 ft length are then fitted together and prestressed by post-tensioned wire cables that run through ducts cast longitudinally in the cylinder walls. Special methods have been developed for joining the 16-ft sections into piles as long as 200 ft.

Merwin Beavers, vice-president, Texas Concrete Products Co., Austin, introduced the film "Low Cost Parking Garage Construction," which illustrated the use of precast decking, combined with cast-in-place construction, for the economical erection of parking garages.

Lightweight prestressed concrete

Cedric Willson, chief engineer, Texas Industries, Inc., Dallas, presided at the Friday morning session which was devoted to prestressed concrete.

"Since the advent of linear prestressing of concrete in the United States on a large scale, there has been an intense interest in the possible use of lightweight aggregate for prestressed concrete members," said Fred A. Koebel, vice-president and chief engineer, Prestressing Inc., San Antonio, Texas, in his paper "Lightweight Prestressed Concrete." Preliminary tests have been run, he said, on beams cast from lightweight expanded shale concrete to determine the applicability of this type of aggregate for prestressed concrete members.

Based on the test data, certain indications of the behavior of lightweight concrete made from expanded shale were obtained, but Mr. Koebel emphasized that "it should be understood that each lightweight aggregate must be considered on its own merit, and what is indicated by these tests is not necessarily true for all lightweight aggregate mixes."

The usual loss in stress in prestressed post-tensioned concrete design is 15 percent for sand and gravel concrete. It would appear, said Mr. Koebel, that an allowance of 25 percent of the original prestressing force would be a satisfactory figure for loss of stress due to shrinkage and creep in the lightweight concrete under tests.

Strength of the mix was adequate for prestressing and the modulus of elasticity of the concrete was also sufficiently high, said Mr. Koebel. Cylinder strength tests at 28 days showed a strength of 6000 psi; the concrete had a cement factor of 6.75 sacks per cu yd of concrete, a slump of 1 to 2 in., and 7½ gal. of water per sack of cement (including absorption in the aggregate).

Tests were also made on similar beams with grouted and nongrouted prestressing steel. The ultimate strength of a beam with grouted wires, noted Mr. Koebel, is greatly increased over the beam without grouted wires. He concluded that there are many benefits to be gained by further tests of lightweight concrete for use in prestressed members.

Shearing strength of prestressed beams

In introducing the paper "Ultimate Shear Strength of Prestressed Concrete Beams," co-authored by Eugene Zwoyer, professor of civil engineering, University of New Mexico, Albuquerque, and C. P. Siess, research associate professor of civil engineering, University of Illinois, Urbana, Professor Zwoyer noted that computation of the shear stress in a beam in terms of the many variables which may affect its behavior is a complex problem, even for ordinary reinforced

concrete beams, while the addition of prestress introduces further complications because of its effect on the formation of cracks due to diagonal tension stresses. The tests and analysis reported by Professor Zwoyer represent the initial stages of a more extensive investigation aimed at the over-all problem of shear strength of concrete beams.

Tests were made, he said, on 34 simply-supported prestressed concrete beams without web reinforcement. All beams were rectangular in cross section and were reinforced with straight wires bonded throughout their length. The variables included the prestress, the percentage and type of steel, the concrete strength, and the ratio of clear span to depth of beam.

Failure in shear of simply-supported rectangular prestressed beams of the type tested, he said, occurred by crushing of the concrete in the compression zone of the beam over an inclined crack. Crushing occurred when the strain in the concrete reached a limiting value and the ultimate load was controlled by the moment rather than by the shear.

The ultimate strength of a beam failing in shear can be expressed by equations of the same type as those used to express the ultimate moment capacity of a beam failing in compression, Professor Zwoyer reported. He then developed and explained briefly the equations arrived at in this investigation. On the basis of limited studies involving only simply-supported beams, Professor Zwoyer reported that the concepts of shear failure developed for prestressed concrete beams seemed to apply equally well to beams of ordinary reinforced concrete.

Control of plastic flow by prestressing

Adrian Pauw, associate professor of civil engineering, University of Missouri, Columbia, and M. H. Thibodeaux, professor of civil engineering, Rice Institute, Houston, discussed the "Control of Plastic Flow in Beams and Slabs by Prestressing."

Although excessive plastic flow deflection may be compensated for by cambering the structural members in some applications and in some types of structural elements, the initial camber may be undesirable because of the time delay in reaching stability. Prestressing can be used to introduce camber in beams, so that in effect the beam has zero weight. In conventional prestressed design, however, noted Professor Pauw, no effort is made to exactly match the dead load so that some deflection due to plastic flow will occur.

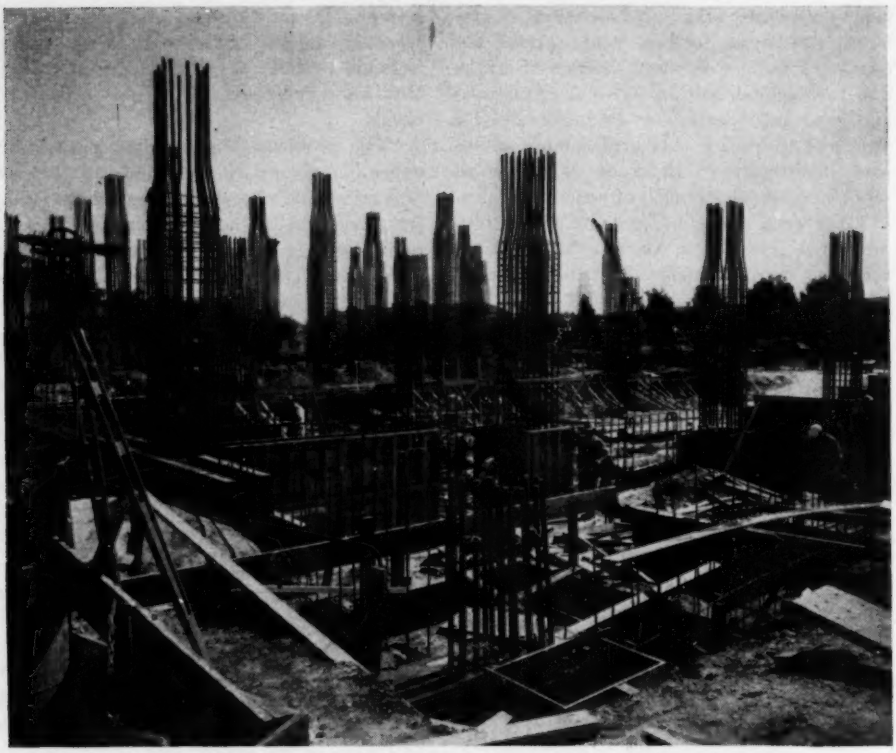
"The problem of controlling plastic flow deflections generally arises only in the case of long spans, where deflections rather than stress due to moment become the critical design criteria," said Professor Pauw. "For such spans, control of deflections can be achieved by means of prestressing with only a small sacrifice in over-all economy."

He noted that present design trends indicate a steady increase in the use of precast concrete units. The use of such units, he said, will inevitably lead to the adoption of higher working stresses to reduce weight. Shrinkage and plastic flow will therefore assume an increasingly important role, especially when such units are prestressed.

He discussed the development of a procedure to design the prestress in such a manner that the combined prestress and load stress at each section of the beam results in a uniform state of stress. For this stress distribution, there can be no differential plastic flow strains of the concrete fibers, he noted; hence, plastic flow deflections are avoided.

Several possible techniques to accomplish this purpose were mentioned. The simplest design for control of plastic flow deflection, he said, involves the use of curved bars or cables combined with the post-tensioning technique; the second possible design, he said, involves the use of shaped members and this procedure may be used with either pre-tensioning or post-tensioning techniques.

The third proposed design presents a solution which is believed to be a novel one. A rectangular section is used with straight prestressing elements in a curved hollow core. The principal advantage of this design, said Professor Pauw, is the elimination of the need for either curved cables or curved soffits. The desired variation in eccentricity between the centroid of the section and the center of gravity of the prestressing steel is achieved by the curved profile of the core. Although the maximum eccentricity which may be obtained with this design is somewhat limited, Professor Pauw felt that the over-all efficiency of this section and the relatively



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simple formwork required may make this design attractive for many applications.

To evaluate design procedure, two quarter-scale lightweight concrete models were constructed for a 25-ft cantilevered slab canopy. One model was reinforced with normal reinforcement and the other was prestressed. Comparative deflections were recorded over a period of time and were correlated with design calculations and measured properties of the concrete mix.

The results of these tests, reported Professor Pauw, indicate that plastic flow deflections can be materially reduced, if not completely eliminated by internal balancing stresses. Maximum deflection stability is achieved, he said, when the initial balancing moment exceeds the sustained load moment, so that a condition of balance ensues after all prestressed losses have occurred.

Prestressed lift slab

"Prestressed concrete is not a panacea for all construction ills or problems. However, when put to the right use it can provide a relatively high quality, watertight, self-sealing, lightweight, nondeflecting medium of construction," emphasized M. M. Lemcoe, supervisor, Structural Research and Development, Southwest Research Institute, San Antonio, Texas, in his paper "Prestressed Slabs and the Youtz-Slick Building Method."

The lift-slab building method was described briefly, which consists basically of casting the upper floors and roof of a structure at ground level, one on top of the other, and then mechanically lifting them to their proper elevation and welding them to the columns. The method is most suited, pointed out Mr. Lemcoe, to buildings not exceeding several stories and to concrete slab construction used in conjunction with steel columns. Reinforced concrete lift-slabs are designed according to the ACI Building Code for flat slab panels.

Individual lift-slabs as large as 150 x 50 ft made of ordinary reinforced concrete have been successfully lifted into position, said Mr. Lemcoe. However, he noted, 12 columns were required to make the design possible because of depth to span considerations.

"By resorting to prestressed concrete," he pointed out, "the dead load due to the slab can be reduced considerably and the maximum distance between columns increased. The utilization of lightweight concrete can afford even greater reduction in slab weight." By using prestressed lightweight concrete, he said, a greater percentage of the total volume of the building is available in the form of usable space.

For spans up to 24 ft, Mr. Lemcoe questioned if there would be any savings realized from a prestressed flat slab design. At the same time, he pointed out that the lift-slab method is not readily adapted to spans much greater than this unless a prestressed slab is used. If the lift-slab method is to be used, where spans in excess of 30 ft are encountered, a prestressed slab would not only be more economical than an unprestressed one, he pointed out, but would probably be mandatory from depth to span ratio considerations.

He said that later work in prestressed slabs revealed that the flat slab design is not the most economical lift-slab for prestressing. A "waffle" type slab indicates, he noted, a saving of approximately 50 percent in prestressing steel over the corresponding flat slab design, with little or no added concrete or labor cost.

Mr. Lemcoe then described the design and construction of the first two-way prestressed slab in the United States to be incorporated in a building, the roof slab for the Engineering Mechanics Building, Southwest Research Institute, erected in 1952. The 88 x 38-ft slab is supported on eight columns with a maximum span length in both directions of 24 ft; slab thickness is 6 in. He emphasized that this was not a demonstration of optimum structural design, but "rather it was an opportunity to incorporate for scientific purposes a two-way prestressed slab into a building which otherwise would have been of conventional design throughout." Model tests were conducted before actual construction of the full scale roof slab.

A post-tensioning system was used in construction of the roof slab. Concrete with a minimum 28-day compressive strength of 5000 psi and a maximum slump of 3 in. was specified. A minimum compressive strength of 3500 psi was required 10 days after the concrete had set, at which time prestressing operations started. The roof was cast in

two sections with the gap running lengthwise. The long direction was prestressed first, he said, by stressing the individual six-wire units by hydraulic jacks. In the short direction, stress was introduced into the wire by separating the two sections of the slab by means of hydraulic jacks placed in the pockets along the gaps. The wires ran continuously across the gap from one slab to the other; the gap was then grouted with a fast-setting grout and the jacks removed when the grout attained the proper strength. He noted that this method of slab separation presented difficulties, since large jacking forces were required.

Lightweight aggregate concrete

One definite conclusion stood out in the paper "Laboratory Work on Lightweight Aggregate Concrete," by R. W. Shafer, senior concrete engineer, Texas Highway Department, Austin; that was, that lightweight aggregate concrete batches cannot be designed by the usual methods which are applicable to conventional aggregates. The only satisfactory method of batch design that has been devised, said Mr. Shafer, is the trial batch procedure. The variable characteristics of lightweight aggregate make the standard design methods unworkable, he reported.

Laboratory work, said Mr. Shafer, indicates that compressive and flexural strength of lightweight aggregate concrete containing 6 sacks of cement per cu yd compare favorably with those of sand and gravel concrete containing 5 sacks of cement per cu yd. He indicated the need for additional investigation of characteristics of lightweight concrete, particularly modulus of elasticity.

Are allowable bond stresses too high?

The general session Friday afternoon, was under the chairmanship of John A. Murlin, Texas Concrete Products Co., Dallas.

Phil M. Ferguson, professor and chairman of civil engineering, Robert D. Turpin, assistant professor of civil engineering, and J. Neils Thompson, professor of civil engineering, University of Texas, Austin, co-authored the paper "Minimum Bar Spacing as a Function of Bond and Shear Strength." The authors reported on an investigation that dealt with splitting due to bond stress, a critical aspect of the stress condition, and they pointed out situations where this should govern design.

"The results indicate conservatism in the ACI Building Code on the matter of minimum bar spacing under some conditions, accompanied by inadequate protection against failure in bond under other circumstances," reported Professor Ferguson.

With the heavily deformed bars that are now standard, bond strength depends chiefly upon bearing of lugs upon concrete and upon shearing stresses thus induced in the concrete between lugs. These set up inclined compressive forces in the concrete, said Professor Ferguson, and this means that radial forces necessarily act against the concrete elements. These radial forces produce tension splitting forces in the concrete which can be quite serious, he emphasized.

The ACI Building Code permits bond stresses as high as $0.10 f'_c$ (but not more than 350 psi) where f'_c is the 28-day standard cylinder compressive strength. These bond stresses are entirely safe, pointed out Professor Ferguson, wherever the bar is encased in a spiral to prevent splitting, or is embedded in a large mass of concrete that will resist splitting, or wherever external forces offset the splitting forces. But, he said, bars are often used in surroundings that do not meet these three conditions. In precast concrete members made with small aggregate, bond resistance may well be lower in these members, said Professor Ferguson, and the spacing of bars might be restricted by bond limitations.

The object of the investigation was to establish minimum allowable bar spacing, but this required considerable study of what bond strength could be developed without any special provision against splitting. "The conclusions," emphasized Professor Ferguson, "are in no way restricted to precast elements."

An "eccentric pull-out test" was devised to give a relatively simple test that would simulate beam conditions. The first large group of tests were made with two-bar specimens at various spacings and cover.

Results of eccentric pull-out tests without stirrups indicate, said Professor Ferguson, that none of these tests "really justifies the use of the present 350 psi working stress in bond, and effective bar spacing of less than two diameters does not develop even the

working stress. This indicates that a restudy of this part of the ACI Building Code is in order."

Although the eccentric pull-out test was intended to simulate beam action, Professor Ferguson reported that spot checks were made with tests on actual beams for verification. These tests, he said, confirmed the general low bond strength obtained from eccentric pull-out tests.

Even with test specimens reinforced with stirrups, said Professor Ferguson, the strengths found were "not adequate to provide a factor of safety of 2.5 on the bond working stress of 350 psi except in a few extreme cases."

As a result of this investigation, where splitting is a factor, Professor Ferguson believed that an allowable bond stress as high as 350 psi generally provides an inadequate factor of safety. With splitting, he said, the allowable bond stress should be a function of the effective bar spacing, with values as low as 90 psi to 310 psi, depending upon bar spacing, stirrups, and concrete strength. Where splitting is not a factor, that is, in mass concrete and over the end reactions of simple spans, Professor Ferguson was of the opinion that the present ACI specifications are probably adequate. "There are many places where potential splitting suggests the need for lowered allowable bond stress," emphasized Professor Ferguson.

He said that preliminary tests of reinforcing bar splices indicate that lap splices in tension also are unsafe when designed by present specifications, and said that this problem was under further investigation.

Dilemma of prestressing

The last session of the two-day meeting closed with a friendly debate between W. L. Powell, consulting engineer, Dallas, and Tadius J. Gut, vice-president, Texas Stressed Concrete Corp., Dallas, on "The Dilemma of Prestressing Concrete."

Southwest Regional Meeting committee

Co-chairmen for the two-day meeting were Phil M. Ferguson, chairman and professor, Department of Civil Engineering, University of Texas, Austin, and John A. Murlin, Texas Concrete Products Co., Dallas. Frank W. Chappell, consulting engineer, Dallas, was program chairman.

The local committee in Houston was headed by S. W. Oberg, chief engineer, Humble Oil and Refining Co., as general chairman. The committees appointed to handle the various events were: *Finance*—chairman, Herbert Shilstone, Jr., Shilstone Testing Laboratory; vice-chairman, P. C. Stinnett, George P. Rackle & Sons Co.; *Technical Program*—chairman, C. A. Bullen, Manhattan Construction Co. of Texas; vice-chairman, Walter P. Moore, consulting engineer; *Publicity*—chairman, Brown Booth, with Brown & Root, Inc.; W. L. Harrell, also with Brown & Root; Harry Hedges, Jr., of Horton & Horton; and George G. Smith, Texas Construction Materials Co.

Registration and Arrangements—chairman, J. B. Baird, Southwestern Laboratories; vice-chairman, H. B. Miller, Raymond Concrete Pile Co.; and George H. Smith, Herbert Voelcker & Associates; *Hospitality*—chairman, George G. Smith, Texas Construction Materials Co.; vice-chairman, Nat Turner, of Freese, Nichols & Turner; and Bill Cornelius, Giffels & Vallet, Inc.; *Inspection*—chairman, Al Bahn, of Parsons, Brinckerhoff, Hall & Macdonald, Inc.; *Ladies Entertainment*—chairman, Mrs. George G. Smith; *Secretary*—Ed C. Jancik, Texas Lightweight Aggregate Co.; and *Assistant Secretary*—J. F. Moore, Concrete Research Foundation.

Teller receives Norman Medal

L. W. Teller, member of the Technical Activities Committee and former Chairman of ACI Committee 325, Structural Design of Concrete Pavements for Highways and Airports, received the Norman Medal at the October convention of the American Society of Civil Engineers in New York. The award was made to Mr. Teller and to the late Dr. Friedrich Bleich as co-authors of a paper "Structural Damping in Suspension Bridges." Mr. Teller is chief, Structural Research Section, Physical Research Branch, Bureau of Public Roads.

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ACI Awards go to Watstein, Ferguson and Thompson, Klein and Crockett

David Watstein, Phil M. Ferguson, J. Neils Thompson, Alden M. Klein, and J. H. A. Crockett will receive ACI Awards from President Henry L. Kennedy at the Golden Anniversary Convention at the Shirley-Savoy Hotel, Denver, Colo., Feb. 22-25, 1954. This announcement comes from the ACI Board of Direction following approval of the report of the Awards Committee.

David Watstein will receive the Wason Medal for "the most meritorious paper" of the volume year,

Effect of Straining Rate on the Compressive Strength and Elastic Properties of Concrete

which appeared in the April, 1953, ACI JOURNAL.

Phil M. Ferguson and J. Neils Thompson will receive the Wason Medal for "noteworthy research" reported in

Diagonal Tension in T-Beams Without Stirrups

in the March, 1953, ACI JOURNAL.

The Wason Awards, established in 1917 by the late Leonard C. Wason, ACI past president, consist of a bronze medal and certificate to each awardee. For material published in the latest volume of *Proceedings* of the American Concrete Institute, an award is made for the "most meritorious paper." The research medal is given for original research work on a subject relevant to Institute activity and which, within the year, has been the subject of an Institute paper.

Alden M. Klein and J. H. A. Crockett will receive the Construction Practice Award for their paper

Design and Construction of a Fully Vibration-Controlled Forging Hammer Foundation

which was published in the January, 1953, ACI JOURNAL.

This award was established in 1944 by the American Concrete Institute to recognize the man on the job for his resourcefulness in translating design into the completed structure.

Award Winners

David Watstein—Wason Medalist

David Watstein, assistant chief, Structural Engineering Section, National Bureau of Standards, Washington, D. C., has been an ACI member since 1941. He has been a frequent contributor to the JOURNAL with papers on physical testing of reinforced concrete.

Mr. Watstein graduated from the University of California in 1930 with a BS degree in civil engineering and joined the staff of the Cement Section, National Bureau of Standards, in physical testing of cements and concrete. While with the Masonry Construction Section of the Bureau, he made tests of masonry materials and engaged in several research projects which included permeability of masonry walls, strength of brick and tile walls, and study of limes in masonry mortars.

Phil M. Ferguson and J. Neils Thompson—Wason Medalists

Phil M. Ferguson, professor and chairman of the Civil Engineering Department, University of Texas, has been an ACI member since 1930, and is a member of ACI Committees 115, Research; 318, Standard Building Code; and 321, Design of Reinforced Concrete Slabs.

After graduating from the University of Texas in 1922 and receiving master's degrees from the University of Texas in 1923 and the University of Wisconsin in 1924, he spent several years with Dwight P. Robin-

son and Co. of New York City in structural design of power plants, industrial buildings, and construction of hotels and apartment buildings.

Professor Ferguson returned to the University of Texas as associate professor in the field of structures and materials in 1928. He was raised to the rank of professor in 1939 and was made chairman of the civil engineering department in 1943. He has also been a consultant on a number of projects.

Professor Thompson is in charge of the Materials Laboratories of the Civil Engineering Department at the University of Texas and is also director of the Balcones Research Center. As director he is in charge of the coordination and development of the center which was established at the International Minerals and Chemical Co. magnesium plant in Austin. The plant was taken over by the University of Texas and about 20 research laboratories are established for research in geology, physics, electronics, and engineering.

After graduation from the University of Texas in 1935, Professor Thompson worked for the Materials and Tests Division, Texas Highway Department. He joined the university staff in 1941.

He is president of the Texas Society of Professional Engineers, a member of ACI, ASCE, ASEE, Highway Research Board, Asphalt Paving Technologists, and the Society for Experimental Stress Analysis.

Alden M. Klein and J. H. A. Crockett —Construction Practice Awardees

Alden M. Klein, assistant manager, New York district, Robert W. Hunt Co., New York, N. Y., has been associated with inspection, testing, analysis, and research problems in connection with cement, aggregates, concrete, and other construction materials since 1929, serving in the capacity of inspector, laboratory technician, and chemist until 1941 when he joined Robert W. Hunt Co. as engineer-of-tests in charge of their New York cement and concrete laboratory.

On leave of absence in 1947 he was engineer-in-charge of a research laboratory established by Pacific Islands Engineers on Guam under a Bureau of Yards and Docks architect-engineer contract for investigating and developing concrete aggregate sources, investigating soil problems, and carrying out investigations and tests of other construction problems. Mr. Klein has been an ACI member since 1949 and is an affiliate member of ASCE.

Mr. Crockett was educated at Oundle School, one of the leading engineering and science public schools in England, and then studied civil engineering at the City and Guilds College, London, for a post-graduate study of building science.

He has worked with a public works contractor as a site engineer and with a firm of consulting reinforced concrete engineers. A particularly interesting job on which he worked early in World War II was the design and construction of radar and anti-aircraft sites on forts 50 miles out from the coast in the North Sea and in Liverpool Bay.

In 1942 Mr. Crockett joined an aircraft firm which carried out especially difficult building and civil engineering works, such as building designs and supervision for the Radar Research Establishment and the Farnborough R. A. E., where aircraft research is conducted. In 1943 the heaviest forging program of the Ministry of Works was being jeopardized seriously by foundation failures. Mr. Crockett conducted research on how foundations for these machines worked, and he developed a satisfactory, practical design method.

Since 1947 he has been working as a consulting engineer and has specialized in foundations for large machinery.

Reardon announces turnpike conference

William J. Reardon, acting chairman, has announced that the Lake Erie to Gulf of Mexico Turnpike Conference is being formed, with headquarters in Cincinnati, Ohio. The object of this conference is to plan cooperation with state, federal, municipal, civic, and existing turnpike bodies in Ohio and southern states for completion of this North-South turnpike.

Safir opens office in Vancouver

Otto Safir, formerly with Safir Engineering Consultants, Ltd., Vancouver, B. C., Canada, has announced the establishment of his own consulting service in Vancouver. Services offered will be as a consulting engineer specializing in structural design.

Positions and Projects — ACI Members

Steinman honored

David B. Steinman has been presented an Honorary Doctor's Degree by the University of Ghent, Ghent, Belgium. In addition to this honor, he has received a citation from the New York State Society of Professional Engineers.

The citation was presented to Mr. Steinman on the occasion of his retirement from the Board of Examiners of Professional Engineers and Land Surveyors of the State of New York in recognition of his service, as past chairman and as a member, and work in advancing professional engineering.

Fiesenheiser appointed director

Elmer I. Fiesenheiser was recently appointed director of the Civil Engineering Department, Illinois Institute of Technology. Professor Fiesenheiser received his BS degree in civil engineering from Purdue University in 1930 and in 1946 his master's degree from Illinois Institute of Technology.

Symposium on nondestructive testing of concrete

The International Union of Testing and Research Laboratories for Materials and Structures (RILEM) has announced an international symposium on nondestructive testing of concrete. The symposium is to be held in the Laboratoires du Batiment et des Travaux Publics, Paris, France, during the week of Jan. 11-17, 1954. Two days are to be devoted to reading of papers and a third to discussions and conclusions. The agenda of the symposium will include: (a) sonic tests, (b) superficial hardness tests, and (c) tests by means of γ rays and neutrons.

Brandes rejoins Nicholson Co.

Raymond L. Brandes has rejoined the Nicholson Co., New York, N. Y., as vice-president and chief engineer, and its parent company, the Wininger Construction Corp., as chief engineer. Mr. Brandes' experience has been chiefly in the bulk storage and industrial building fields.

Bissett appointed associate director

James R. Bissett has been appointed associate director of the Engineering Experiment Station, University of Arkansas, Fayetteville, Ark. In addition to his new duties he will continue as professor of civil engineering at the university.

Coleman enters private practice

Percy L. Coleman resigned as senior structural engineer with Sverdrup and Parcel, Inc., consulting engineers, St. Louis, Mo., to enter private consulting practice in St. Louis. Prior to his association with Sverdrup and Parcel, Mr. Coleman was chief structural engineer in the general engineering department of Monsanto Chemical Co.

Short course

The Eighth Annual Short Course for technicians of the ready-mixed concrete, sand, and gravel industries was held at the University of Maryland, College Park, Md., this past November. As in the past the short course was under the joint sponsorship of the National Ready Mixed Concrete Assn. and the National Sand and Gravel Assn.

Included in the subject matter of the course were the following: (1) factors affecting strength and consistency of concrete; (2) air entrainment and use of admixtures; (3) methods for proportioning concrete mixtures, including practice calculations; (4) discussion of aggregate and concrete specifications; (5) miscellaneous uses of aggregates iucluding bituminous mixtures, railroad ballast, and filter media; (6) discussion and demonstration of tests of concrete and aggregates; and (7) group discussions of production and control problems in the sand, gravel, and ready-mixed concrete industries.

Morris receives honorary degree

Samuel B. Morris, general manager and chief engineer, Department of Water and Power, City of Los Angeles, Calif., was awarded an honorary degree of Doctor of Laws from the University of California during the past commencement season.

LOOKING AHEAD

January 5-7, 1954—American Road Builders' Assn. Annual Meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

January 12-13, 1954—Second Annual Quality Concrete Conference, Vanderbilt University, Nashville, Tenn.

January 12-14, 1954—Annual Meeting, National Constructors Assn., Hotel Commodore, New York, N. Y.

January 12-15, 1954—33rd Annual Meeting, Highway Research Board, National Academy of Sciences Building, Washington, D. C.

January 17-21, 1954—Annual Convention and Exposition, National Assn. of Home Builders, Conrad Hilton Hotel, Chicago, Ill.

January 25-28, 1954—Plant Maintenance and Engineering Show, International Amphitheatre, Chicago, Ill.

January 28-29, 1954 — Canadian Conference on Prestressed Concrete, University of Toronto, Toronto, Ont., Canada

February 1-5, 1954—Spring Committee Week, American Society for Testing Materials, Shoreham Hotel, Washington, D. C.

February 7-10, 1954—34th Annual Convention, National Concrete Masonry Assn., Shoreham Hotel, Washington, D. C.

February 15-19, 1954—38th Annual Convention, National Sand and Gravel Assn., Conrad Hilton Hotel, Chicago, Ill.

February 15-19, 1954—24th Annual Convention, National Ready Mixed Concrete Assn., Conrad Hilton Hotel, Chicago, Ill.

February 15-19, 1954—Atlanta Convention, American Society of Civil Engineers, Hotel Biltmore, Atlanta, Ga.

February 22-24, 1954—37th Annual Convention, National Crushed Stone Assn., Conrad Hilton Hotel, Chicago, Ill.

February 22-25, 1954—Golden Anniversary Convention, American Concrete Institute, Shirley-Savoy Hotel, Denver, Colo.

February 24, 1954—4th Annual Convention, American Concrete Agricultural Pipe Assn., Fairmont Hotel, San Francisco, Calif.

February 25-27—46th Annual Convention, American Concrete Pipe Assn., Fairmont Hotel, San Francisco, Calif.

Magnel visits United States and Canada

Prof. Gustave Magnel of the University of Ghent, Ghent, Belgium, will attend the Prestressed Concrete Convention in Toronto, Ont., Canada, Jan. 28-29, 1954, on the first portion of a lecture tour through the U. S. and Canada. He will lecture in Boston, Mass., and at Drexel Institute, Philadelphia, Pa. The Philadelphia meeting, Feb. 3, 1943, sponsored by the Portland Cement Assn. and Drexel Institute, comes as a sequel to a series of lectures sponsored by PCA and Drexel in 1952.

It is of interest to note that one of Professor Magnel's former students, Charles C. Zollman, well known to ACI members through his services to the Institute, lectured at one of the 1952 sessions.

Following the Philadelphia meeting, Professor Magnel will visit Norfolk, Va., Feb. 5, 1954, where he will be guest at a meeting sponsored by the Hampton Roads Post of the Society of American Military Engineers.

The rest of the schedule is tentative and includes New Orleans, La., on Feb. 8, and subsequent stops on the West Coast.

Brennan appointed chairman

Paul J. Brennan has been appointed chairman of the department of civil engineering at the University of Delaware, Newark, N. J. Formerly he was a member of the civil engineering faculty at Yale University.

Raphael accepts new post

Formerly with the Bureau of Reclamation, Denver, Colo., Jerome M. Raphael has accepted a new position as associate professor of civil engineering at the University of California, Berkeley, Calif.

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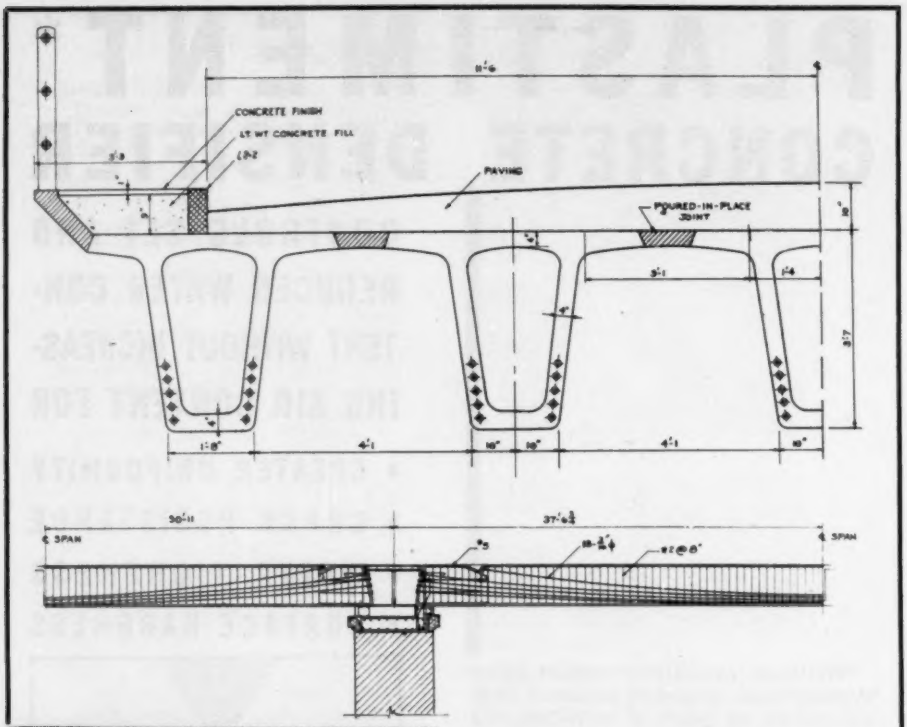

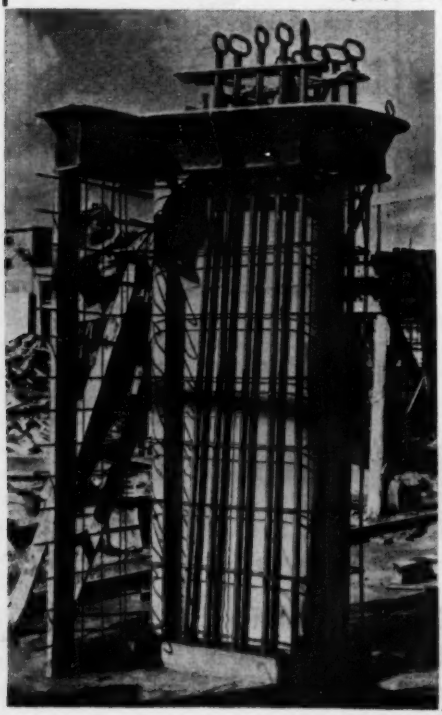

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Zollman at Drexel

Charles C. Zollman, chief engineer at Vacuum Concrete Inc., Philadelphia, Pa., has announced that in addition to his regular duties he will serve as adjunct professor of civil engineering in charge of all studies pertaining to prestressed concrete in the Graduate School of Engineering at Drexel Institute in Philadelphia. Two years ago Drexel organized, jointly with the Portland Cement Assn., a series of lectures on prestressed concrete, the outcome of which was a regularly scheduled course in prestressed concrete. Mr. Zollman, a former student of Prof. Gustave Magnel of the University of Ghent, Ghent, Belgium, played a prominent role in these lectures.

In addition to his various duties, Mr. Zollman has been one of the active participants in the "Current Reviews" section of the JOURNAL. His voluntary service in reviewing foreign publications has been a great aid in bringing foreign literature to the attention of ACI members.

Large resigns chairmanship

George E. Large, chairman of the department of civil engineering at Ohio State University, Columbus, Ohio, since 1947, has resigned to devote full time to teaching and research in reinforced concrete design.

R. A. Moncrieff

R. A. Moncrieff, vice-president, Charles T. Main, Inc., consulting engineers, Boston, Mass., died recently at Newton, Mass. He was widely known in the hydroelectric engineering field, and also had participated lately in planning of the atomic energy development at Richland, Wash.

John Henry Bateman

John Henry Bateman, professor of civil engineering, Louisiana State University, Baton Rouge, La., since 1936, died recently. After graduating from the University of Michigan in 1915, Professor Bateman entered the Michigan State Highway Department and served as director of its laboratories at Ann Arbor from 1919 to 1924. For four years he was also engineer-manager of the Berrien County (Michigan) Road Commission. He was the author of a standard college text, *Highway Engineering*.

William Henry Gravell

William Henry Gravell, consulting engineer, Philadelphia, Pa., and an alumnus of the University of Pennsylvania, died recently. Mr. Gravell was connected with the construction of such structures as the Pan-American and Justice Department buildings in Washington, D. C.; the Bethesda Medical Center; and buildings for the U. S. Naval Academy, the U. S. Military Academy, and several colleges.

Paul E. Jeffers

Paul E. Jeffers, consulting engineer, Los Angeles, Calif., and president, California State Board of Registration for Civil and Professional Engineers since 1947, died in Los Angeles recently. He was a graduate of Stanford University. In practice since 1917, Mr. Jeffers was connected with the structural design of many of southern California's buildings.

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Who's Who This Month

M. D. Morris

M. D. Morris, head, New York Office, Soiltest, Inc., Chicago, Ill., and materials engineer, Bechtel Corp., writes about "Pier 57 Concreted Through the Winter," p. 281.

Mr. Morris received his engineering education at Cornell University where he was a McMullen scholar. While attending college he did survey work for Turner Construction Co. Subsequently he was liaison officer for the Curtiss-Wright Corp., Airplane Division, and later was associated with the Bureau of Sewage Disposal Design, Department of Public Works, New York, N. Y.

Mr. Morris served with the Corps of Engineers, U. S. Army, on Okinawa and later was head of engineering in New York for the Venezuelan Institute of Sanitary Works. For two years he operated a private practice in New York at which time he was sales engineer for a generator manufacturer, a phase of which was the steam curing of Pier 57 described in this article. He is an associate member of ASCE and a military engineer member of SAME.

J. J. Waddell

"Factors Influencing the Strength of Concrete as Revealed by a Six-Year Record of Concrete Control," p. 285, is J. J. Waddell's second contribution to the ACI JOURNAL. This article was prepared while he was materials engineer for the U. S. Bureau of Reclamation, Lindsay, Calif. He is now resident engineer in charge of materials testing and control in Louisiana for Palmer and Baker, Inc., consulting engineers, Mobile, Ala.

After graduation from the University of Arizona in 1929 he was employed at various engineering assignments in Arizona and California before joining the Bureau of Reclamation in 1934 as a junior engineer at Parker Dam, Calif. Mr. Waddell's subsequent assignments with the Bureau were in the laboratory and concrete control sections at Shasta and Friant dams. After a short absence during 1942-43 he returned to the Bureau to take charge of concrete and earthwork control for the Friant-Kern Canal, followed in 1950 by appointment as head of the materials testing and control section for construction of the Friant-Kern Canal distribution systems. Mr. Waddell resigned from this position early this year to accept his present position in New Orleans, La. He has been an ACI member since 1938.

William Prager

"Limit Analysis and Design," p. 297, is described by William Prager, professor of applied mechanics, Brown University, Providence, R. I.

Professor Prager graduated in civil engineering in 1925 and received his Doctor of Engineering degree in civil engineering in 1926 from the Institute of Technology, Darmstadt, Germany.

In 1927-28 he lectured at the Institute of Technology, Darmstadt, Germany; in 1928-32 he was acting director, Institute of Applied Mechanics, University of Goettingen, Germany; and in 1933 was professor of applied mechanics, Institute of Technology, Karlsruhe, Germany.

In 1934 Professor Prager became a professor of theoretical mechanics, University of Istanbul, Turkey, and held that position until 1941 when he joined the faculty of Brown University as professor of applied mechanics.

E. W. Scripture, Jr., S. W. Benedict, and D. E. Bryant

An investigation of "Floor Aggregates" is reported on p. 305 by E. W. Scripture, Jr., S. W. Benedict, and D. E. Bryant.

Dr. Scripture, vice-president in charge of research, Master Builders Co., Cleveland, Ohio, has been an ACI member since 1931 and has contributed frequently to the JOURNAL as author and discusser of papers. He attended Harvard University where he obtained his BA degree in 1920, MA in 1922, and PhD in 1924. From 1923-30 Dr. Scripture served as research chemist for several organizations and in 1930 became associated with Master Builders Co. Besides his membership in ACI he is affiliated with ASTM,

American Chemical Society, Cleveland Engineering Society, American Ceramic Society, Society of Chemical Industry, and Alpha Chi Sigma.

Mr. Benedict, director of research, Master Builders Co., graduated from the University of Illinois in 1936. He served as junior materials engineer in the concrete research branch of the Illinois Division of Highways Bureau of Materials until 1939 and as materials engineer in the Cement and Concreting Materials Section, National Bureau of Standards, until 1949 except for three years' service with the Army Air Force during World War II which included a year's assignment as structural engineer with the National Advisory Committee for Aeronautics. Mr. Benedict left the National Bureau of Standards in 1949 when he joined the staff of Master Builders Co. He has been an ACI member since 1941.

Mr. Bryant, senior research assistant, Master Builders Co., has had diversified experience as a chemist in the manufacturing of portland cement. He attended the University of Des Moines, Des Moines, Iowa, and completed a course in business management at the Capital Commercial College of Des Moines.

In 1933 he was briefly employed by the Chrysler Corp. on time-study work in Detroit, Mich. From 1934-44 he was employed by the Green Bag Cement Co., Pittsburgh, Pa., as control chemist, physical tester, assistant chemist, and research chemist. In 1941-42 Mr. Bryant took additional courses in chemistry by attending night school courses at Pennsylvania State College. From 1944-46 he was plant chemist with the Longhorn Portland Cement Co., San Antonio, Texas. He joined the research staff of Master Builders Co. in 1946.

Grover L. Rogers

Grover L. Rogers, author of "Validity of Certain Assumptions in the Mechanics of Prestressed Concrete," p. 317, is an associate professor of structural engineering, Virginia Polytechnic Institute, Blacksburg, Va.

Professor Rogers received a BS degree in civil engineering and MS degree in applied mechanics from Virginia Polytechnic Institute followed by MS and Doctor of Science degrees from Harvard University. He served

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as teaching fellow in civil engineering at Harvard from 1948-51. During the summers he worked in the field and office for the U. S. Corps of Engineers, U. S. Bureau of Public Roads, Applied Physics Laboratory of Johns Hopkins University, and the Preload Corp. In World War II he served for 19 months with the Corps of Engineers.

After completing his degree program he was awarded a U. S. Government Fellowship under the Fulbright Act for further study and research in Belgium where he was associated with Prof. Gustave Magnel at the University of Ghent Concrete Research Laboratories.

Professor Rogers was a research engineer for the Naval Research Laboratory, Washington, D. C., where he was concerned primarily with problems in the dynamic resistance of structures, prior to joining the faculty of Virginia Polytechnic Institute last September.

He is a junior member of ACI, ASCE, and a member of Chi Epsilon, Tau Beta Pi, Phi Kappa Phi, Omicron Delta Kappa, Sigma Xi, and a registered professional engineer in Virginia.

Errata

The following correction should be made in "Minimum Standard Requirements for Precast Concrete Floor Units," ACI JOURNAL, September, 1953.

p. 15, line 16—

¾ in. should read ⅜ in.

The following correction should be made in the review "Effect of Entrained Air on Strength and Durability of Concrete Made with Various Maximum Sizes of Aggregates," ACI JOURNAL, October, 1953.

p. 184—the sixth and seventh lines in the last paragraph should read ". . . about 9 percent entrained air in the mortar fraction regardless of . . ."

Hall changes position

John F. Hall is now assistant to the vice-president, North American Cement Co., New York, N. Y. Previously he was district engineer for the Portland Cement Assn. in New York.

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Will elected president

Jake L. Will, former vice-president in charge of aggregates operations, has been elected president of Southern Pacific Milling Co., Santa Barbara, Calif. Mr. Will has been in charge of the various aggregates operations throughout the tri-county area since 1941.

Fenlon opens Atlanta office

Hugh F. Fenlon, formerly structural engineer for William J. J. Chase and Associates, Atlanta, Ga., has opened a consulting office in Atlanta. Consulting services will cover structural designs, investigations and reports, and special structures.

Danforth appointed city engineer

Herman Danforth, formerly chief engineer, Honolulu office, Harland Bartholomew and Associates, St. Louis, Mo., engineering and planning firm, has accepted an appointment as city engineer of Rockford, Ill.

New Members

The Board of Direction approved 68 Individual applications, 1 Corporation, 17 Juniors, and 21 Students making a total of 79 new members. Considering losses due to deaths, nonpayment of dues, and resignations the total membership for the month of October is 6308.

Individual

ACOSTA, LAWRENCE, Phoenix, Ariz. (Struct. Engr., Lescher and Mahoney)

ALBET, JUAL, Bogota, Colombia (Struct. Engr., Martinez Cardenas and Cia., Ltd.)

ALLAN, JOHN D., Hamilton, Ont., Canada (Sales Manager, Steel Co. of Canada, Ltd.)

ANEZ, WILLIAM BAZO, Zulia, Venezuela (Mech. Engr., Shell de Venezuela)

AUSTIN, DONALD S., Honolulu, Hawaii (Assoc. Engr., Austin and Towill)

BAUTISTA, ROBERTO BENGCO, Agana, Guam, M. I. (Civil Engr., U. S. Naval Base)

BELLOWS, GEORGE FERRIS, Houston, Texas, (Secretary of Company, Engr., W. S. Bellows Constr. Corp.)

BENNETT, J. GARDNER, Honolulu, Hawaii (Prof. of Civil Engrg., University of Hawaii)

BINNIE, R. F., Vancouver, B. C., Canada (Chf. Engr., General Construction Co., Ltd.)

BRUNSTROM, ALFRED F., Albany, Ore. (Bldg. and Constr. Supt., Linn Plywood Corp.)

CARVER, DALE R., Manhattan, Kan. (Assoc. Prof. of Applied Mechanics, Kansas State College)

DAVIES-GRAHAM, LEWIS RICHARD, Riverdale, Western Australia (Works Manager, Swan Portland Cement, Ltd.)

EATON, EDWARD E., Irwin, Idaho (Concrete Supt., Palisades Contractors, Palisades, Idaho)

ELLIS, WILLARD, Denver, Colo. (Materials Engr., USBR)

EVANS, WILLIAM VICTOR, Wellington, New Zealand (Plant Maint. Engr., Certified Concrete, Ltd.)

FERGUSON, C. H., Bellevue, Wash. (Regional Engr., Intrusion-Prepakt, Inc., Seattle, Wash.)

GALLIA, A., Hobart, Tasmania, Australia (Civil Engr., Public Works Dept.)

GENSERT, RICHARD M., Cleveland, Ohio (Struct. Design of Commercial Bldgs.)

GOLDEN, V. V., Longmont, Colo. (Ready-Mixed Concrete)

HAGUE, JOHN M. JR., East Orange, N. J. (Struct. Engr., Nicholson Co., New York, N. Y.)

HARVEY, LINCOLN, Ultimo, Australia (Field Engr., John Lysaght (Australia) Pty., Ltd.)

HAYNES, CHARLES H., Cleveland, New York (Distributor of Construction Materials)

HILL, G. B., Claremont, Western Australia (Senior Lecturer in Civil Engrg., University of Western Australia)

HOGAN, M. H., New Orleans, La. (Pres. and Gen. Mgr., Hogan Bros., Inc.)

IDORN, G. M., Naerum, Denmark (Civil Engr., Research Asst., Danish National Institute of Bldg. Research)

JACKSON, J. O., Pittsburgh, Pa. (Vice Pres. in Chg. of Research and Engrg., Pittsburgh-Des Moines Steel Co.)

JARVIS, JAMES M., Clarksburg, W. Va. (Pres. and Gen. Mgr., Jarvis-Courtney Corp.)

KELLOW, WILLIAM G., Oklahoma City, Okla. (Struct. Engr., Dolese Co.)

KONZEN, ALLAN S., Seattle, Wash. (Struct. Engr., John Graham and Co.)

KUTTNER, G. H., Johannesburg, South Africa (Managing Director, Water Sealers (Pty) Ltd.)

LESTER, SEYMOUR, Los Angeles, Calif. (Sr. Struct. Engr., Calif. State Div. of Arch.)

LEWIS, DAVID ARTHUR, Barry, United Kingdom, Wales (Sr. Engr., Ecrofnier and Partners, Ltd., Cardiff)

LOUREIRO, LUIS M., Montevideo, Uruguay (Civil and Chf. Constr. Engr., Christiani and Nielsen, S. A.)

LYSAGHT, CORNELIUS, Brisbane, Australia (Arch. Draftsman, Commonwealth Dept. of Works)

MALDONADO, CLARENCE ACEVEDO, Hato Rey, P. R. (Constr. Supv., Puerto Rico Industrial Development Co., San Juan, P.R.)

MEDART, WALTER F., Oakland, Calif. (Detailer and Struct. Designer, Herrick Iron Works)

MIDDENDORF, KARL H., Kansas City, Mo. (Vice Pres., and Chf. Engr., Prestressed Concrete Corp.)

MILLER, ROSS D., Houston, Texas (Struct. Engr., Brown and Root, Inc.)

MUNSELL, A. A., Birmingham, Ala. (Field Supt., Constr., Brice Bldg. Co., Inc.)

NELSON, ROBERT T., Chicago, Ill. (Struct. Designer, F. J. Kornacker and Associates)

NOVIKOFF, GEORGE V., Los Angeles, Calif. (Struct. Engr.)

PAULET, E. G., Maracaibo, Venezuela (Civil Engr., Creole Petroleum Corp.)

PAYOT, OSCAR J., Caracas, Venezuela (Engr., Oficina Tecnica B. Nouel)

PECORA, JOHN J., Baltimore, Md. (Engr., Allied Contractors, Inc.)

POLIVKA, JAN F., West Hempstead, N. Y. (Struct. Engr., Borsari Tank Corp. of America)

PRATT, JAMES A., Troy, Ohio (Sales Engr., Fenton Constr.)

RAMIREZ, ENRIQUE BUSTAMENTE, Guatemala City, Guatemala (Civil Engr.)

REEVES, ROGER A., Denver, Colo. (Pres., Centennial Eng. Co.)

RENSOLI, RENE DE LA LLANA, Mexico, D. F., Mexico (Civil Engr., Alarcon-Cornish-Zendejas)

RICHARDSON, ELBERT R., Bellevue, Nebr. (U. S. Corp. of Engineers, Omaha District)

RIVKIND, L. E., Roselle Park, N. J. (Foaming Agent, Air-Entraining Agent, Mearl Mfg. Corp.)

RIZZO, WILLIAM J., South Boston, Mass. (Pres. National Construction Co.)

ROBERTSON, I. H., Tyler, Texas (Supt. and Estimator, Wilks, Dake, and Steed)

ROSS, WILLIAM A., Ancon, C.Z. (Gen. Contr. and Cons. Engr.)

SAXER, EDWIN L., Toledo, Ohio (Prof. of Civil Engrg., Chm., of Civil Engrg. Dept. University of Toledo)

SCHMIDT, CHESTER E., Milwaukee, Wis. (Struct. Engr.)

SCHUPACK, MORRIS, Arlington, Va. (Struct. Engr., in Chge. of Bridge Group, Preload Engineers, Inc.)

SHIDELER, R. T., South Charleston, W. Va. (Staff Engr., Supv. of Struct. and Civil Engrg., Carbide and Carbon Chemicals Corp.)

SZALAY, JOSEPH F., Indianapolis, Ind. (Chf. Engr., Construction Management, Inc.)

TAIN, JOSE RAMON B., La Habana, Cuba (Inspector, Supv., Chas. Martin Co. of Cuba)

UMBACH, LAWRENCE H., Chicago, Ill.. (Pres. and Gen. Mgr., Superior Concrete Accessories, Inc.)

VARGAS, CARLOS G., Barranquilla, Colombia (Cia. Constructora de la Costo)

VARGAS, ROBERTO FERRO, Cali, Colombia (Civil Engr. National Univ. Bogota, Colombia)

WAGNER, WALTER K., Albuquerque, New Mexico (Chf. Engr., Albuquerque Gravel Products Co.)

WARFORD, K. C., Houston, Texas (Dept. Head in chg. Physical Testing and Concrete Design, Engineers Testing Lab.)

WEST, JACK EVERETT, Laredo, Texas (Constr. Engr., Supv., Corps. of Engineers)

YOUNG, JOHN T., Phoenix, Ariz. (Exec. Sec., Central Arizona Concrete Assn.)

ZILM, EDWARD F., Corona Del Mar, Calif. (General Contr.)

Corporation

MIRON AND FRERES, LTD., Montreal, Canada (Louis A. Gottheil, Engr. and Chf. of Lab., Concrete Div.)

Junior

BAHEN, JOHN E., Toronto, Ont., Canada (Matls. Engr., Corps. of Engrs., Atlantic Distr., N.Y.C.)
CARLSON, STANLEY V., Portland, Ore. (Struct. Engr., Burns, Bear, McNeil and Schnieder)
CHANG, YIEN-SUN, Urbana, Ill. (Research Asst., University of Illinois, Engrg. Experiment Station)
CHRISMAN, LEON J., Tulare, Calif. (Distr. Engr., Tulare Irrigation District)
DOUGLAS, JOSEPH RICHARD, Charlotte, N. C. (Est. and Detailer, Southern Engrg. Co.)
GRAMLING, WADE L., Pittsburgh, Pa. (Field Engr., PCA)
LEVY, MELVIN SOL, Brooklyn, N. Y. (Designer of Foundations, New York Naval Ship Yard)
MATHEUS, DR. RAMON C., Maracaibo, Venezuela (Prof. and Insp. of Engrg. Works, Universidad del Zulia)
NAKAO, JAMES I., San Francisco, Calif. (Inspecting and Installations Officer, HQ. USAF, Washington, D.C.)
REYES, SALVADOR F., New Haven, Conn. (Instr. in Civil Engrg., Univ. of the Philippines, Quezon City, P. I.)
RICKABUS, DON E., Detroit, Mich. (Salesman, W. H. Anderson Co., Inc.)
SOUTHWICK, WILLIAM R., San Francisco, Calif. (Testing Lab., Robert W. Hunt Co.)
SPECTER, MARVIN M., New Rochelle, N. Y. (Civil and Res. Engr., Howard, Needles, Tammen and Bergendoff, New York, N. Y.)
TANI, ALBERT N., Los Angeles, Calif. (Jr. Civil Engr., State of Calif., Dept. of Public Works, Div. of Highways)
VIVAS, ROMAN PACHECS, Caracas, Venezuela, (Constr. Engr., Corporacion Venezuela de Fomento)
WILLIAMSON, JAMES W., Toronto, Canada (Struct. Engr., Edgar A. Cross)

Student

BAUMEISTER, ROBERT G., St. Paul, Minn. (Engrg. Asst., University of Minnesota)
BLAESS, JACK L., Brookings, S. D. (South Dakota State College)
CEDARHOLM, CHARLES, Elmhurst, Ill. (University of Illinois)
DURFEE, DANIEL A., Peoria, Ill. (University of Illinois)
GARCIA-REYES, CARLOS, Champaign, Ill. (University of Illinois)
HILL, MARS A., Chicago, Ill. (University of Illinois)
JOHNSON, DAVID E., Chicago, Ill. (University of Illinois)
MUNZ, RAYMOND JOHN, Urbana, Ill. (University of Illinois)
NUCCITELLI, SAUL A., Yonkers, N. Y. (New York Univ.)
PERALTA, ALFREDO, Boston, Mass. (MIT)
PEYTON, GERALD, Laramie, Wyo. (University of Wyoming)
RUDOLPH, ROBERT L., Laramie, Wyo. (University of Wyoming)
RUTKOWSKI, DONALD V., Chicago, Ill. (University of Illinois)
SALINAS, FERNANDO, Habana, Cuba (Havana University)
SAUNDERS, RAYMOND D., Laramie, Wyo. (University of Wyoming)
SHEARS, JACK R., Hutchinson, Kan. (University of Kansas)
SILVERS, EDWIN D., New York, N. Y. (College of Engrg., New York Univ.)
SMITH, DELBERT RAY, Urbana, Ill. (University of Illinois)
VINCENT, RENE, Quebec, Que., Canada (Laval University)
ZODKEVITCH, MORDEHAI, Bronx, N. Y. (New York University)

Honor Roll

February 1—November 30, 1953

J. E. Jellick and James A. McCarthy still share first place honors with 12 credits each. Newlin D. Morgan, Jr., holds second place with 9 credits. Third place, with 6 credits to each ACI member, is divided between MacGregor S. Anderson, F. Thomas Collins, J. R. Florey, Samuel Hobbs, Shigeo Okubo, and C. H. Scholer.

Special appreciation for real "member-getting" goes to H. B. Tryhorn, a 1953 Junior member, who has sponsored four applicants for membership in ACI so far this year.

J. E. Jellick	12
James A. McCarthy	12
Newlin D. Morgan, Jr.	9
MacGregor S. Anderson	6
F. Thomas Collins	6
J. R. Florey	6
Samuel Hobbs	6
Shigeo Okubo	6
C. H. Scholer	6
Phil M. Ferguson	5½
Elmo C. Higginson	5½
Walter H. Price	5½
Herbert J. Gilkey	5
Henry L. Kennedy	5
Joaquin Spinel L.	5
Carlos D. Bullock	4
K. A. Howard	4
M. A. Sozen	4
J. A. Thomen	4
H. B. Tryhorn	4
Somthob Dhanuckamin	3
W. C. Hansen	3
Myle J. Holley, Jr.	3
J. B. Jacobsen	3
T. C. Kavanagh	3
W. R. Lorman	3
Eric C. Molke	3
E. R. Needles	3
Kiyoshi Okada	3
Lawrence L. Schwinn	3
Fred F. Van Atta	3
Igor V. Voshinin	3
George D. Youngclaus	3
C. C. Zollman	3
T. Y. Lin	2½
Platon T. Mikluchin	2½
Arbak A. Abdalian	2
Robert F. Adams	2
Harold Anson	2
Hugh Barnes	2
Reinard W. Brandley	2
V. J. Cespedes	2
Edward M. Corbett	2
W. S. Cottingham	2
M. A. Craven	2
A. D. Engle	2
Eugene Fallon	2
Benjamin P. Felix	2
E. M. Freeman	2
John Gilliland, Jr.	2
K. Hajnal-Konyi	2
Bernard S. Harder	2
John M. Hayes	2

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—the ranks of Payroll Savers are growing: On June 30th sales of $25 and $50 Savings Bonds, the sizes purchased chiefly by Payroll Savers, were 6% and 9% higher than in the corresponding period of 1952.

It costs no more to give your Christmas Bonus in Savings Bonds. To the Payroll Saver, a One Hundred Dollar Savings Bond looks bigger and better than a check for $75. *Make this a merrier Christmas for every employee. Give the gift that keeps on giving.*

J. B. Herbish	2
Chuzo Itakura	2
R. F. Jones	2
M. B. Klock	2
Federico Leon	2
Gerardo Linares	2
B. W. Lorance	2
William McGuire	2
Robert L. Mauchell	2
Frank B. May	2
Eugene Mirabelli	2
William G. Murphy	2
John P. Ottesen	2
Adrian Pauw	2
George Pinter	2
Leo W. Schmidt	2
C. P. Siess	2
George G. Smith	2
Herman Tachau	2
E. C. Thoma	2
E. W. Thorson	2
C. B. Van Alstine	2
C. D. Wailes, Jr.	2
S. J. Warberg	2
William H. Wisniski	2
Arthur G. Wood	2
B. R. Wood	2
J. S. Yike	2

Tools, Materials, Services

Under this heading note will be made from time to time of producer literature of presumed technical interest (and available from its source for the asking) to ACI users of tools, equipment, materials, accessories and special services.

Straw spreader

A fast way of laying straw on a freshly seeded road embankment is shown in use on a Baltimore-Washington highway. The contractor used a New Holland forage harvester which spreads straw mulch evenly in any direction. Formerly, straw was scattered by hand and held on the sloping ground by twine criss-crossed between stakes.

This equipment also offers possibilities in curing of concrete pavements. Much of the labor necessary for spreading straw is eliminated, and the ease, uniformity, and speed with which this operation is performed might make it a useful piece of equipment on large scale paving projects.—New Holland Division, Sperry Corp., New Holland, Pa.

Space heating

American Air Filter Co. has published a booklet, "Guide to the Selection and Use of Portable Space Heaters," in which safety is stressed as the major factor to consider in selecting space heaters. The company's line, the Herman Nelson space heaters, have vents to carry off combustion products, the sealed-flame principle, and automatic controls. The risk of carbon monoxide and other fumes, as well as sparks, smoke, and soot, is said to be eliminated by these features.—Herman Nelson Division, American Air Filter Co., 1824 Third Ave., Moline, Ill.

Concrete slab finishing

Builders can level concrete slabs in much less time and do a better job, the manufacturer claims, with "Concrete Smoothie," now available from Columbus Steel Fabricating Co.

A 2-hp gear reduction motor, working through an eccentric, activates the runners in an easy back-and-forth motion while the operator pulls the whole device across the slab. The runners, which are detachable, can be adapted to any width.—Columbus Steel Fabricating Co., Columbus, Neb.

Gravel plants

Pioneer Engineering Works, Inc., has announced a series of individual bulletins describing and listing the specifications on the company's line of bottom-deck feed plants for gravel aggregate production. This line consists of seven sizes of plants. Screening areas range from 40 sq ft for the 17-V to 96 sq ft for the 46-VE. Plant set-ups are shown and color diagrams trace the flow of material through the plants.—Pioneer Engineering Works, Inc., 1515 Central Ave., Minneapolis 13, Minn.

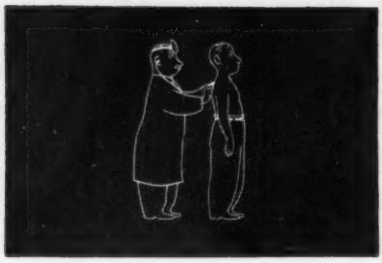
Storage battery service manual

Publication of a revised storage battery service manual has been announced by the Assn. of American Battery Manufacturers. The booklet covers in non-technical language how a battery is constructed, how it works, how to maintain battery stock, how to install and service automotive batteries, and how to make certain battery repairs. Definition of often-used electrical terms and a complete index are also included.

A copy of the 44-page publication, "Storage Battery Technical Service Manual," may be obtained at $0.30 per copy.—Assn. of American Battery Manufacturers, 2706 First National Tower, Akron, Ohio

Masonry saw

Victor Engineering Corp.'s Valor II masonry saw utilizes a combination of high-tensile strength aluminum alloy casting, angle iron, and pressed steel which is said to make one of the lightest and strongest machines available. A front end head height adjustment, the manufacturer claims, gives instant height positions while a turnbuckle set-up on the back bar allows the head position to be varied. The Feedmatic principle has been retained which is said to eliminate operator guesswork as to correct blade pressures. The machine is available in wet as well as dry cut models.—Victor Engineering Corp., 15 Maple Ave., Paoli, Pa.



...before it TALKS

...is the way our doctors put it—"Our chances of curing cancer are so much better when we have an opportunity to detect it *before it talks.*"

That's why we urge you to have periodic health check-ups that *always* include a thorough examination of the skin, mouth, lungs and rectum and, in women, the breasts and generative tract. Very often doctors can detect cancer in these areas long before the patient has noticed any symptoms.

For more life-saving facts phone the American Cancer Society office nearest you, or write to "Cancer"—in care of your local Post Office.

American Cancer Society

Block machines

A four-page folder covering their plain pallet block machines is available from the Gene Olsen Corp. The folder covers both machines, the "King," 6 block at a time, and the "Senior," three 8-in. equivalents per cycle.—Gene Olsen Corp., 432 Grace St., Adrian, Mich.

Vermiculite analysis report

Zonolite Co. has released a manual summarizing vermiculite's chemical and physical properties.

Subjects covered in the eight-page report are vermiculite's chemical composition, base exchange characteristics, solubility, water absorption, chemical carrier capacity, *pH* and buffering capacity, thermal properties, and a sieve analysis of grades.

The report also lists typical chemical and physical uses of vermiculite, including uses as loose-fill insulation, as a catalyst in organic compound preparation, as a filler, and as a packing material.—Zonolite Co., 135 S. LaSalle St., Chicago 3, Ill.

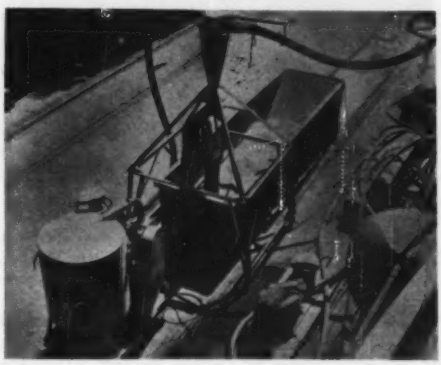
Crushing and screening plant

Pioneer Engineering Works, Inc., has added a duplex crushing and screening plant to its line of portable plants.

The plant, Model 35-S, is a lightweight, in-line plant, primarily designed for use in gravel pits. The in-line feature means that the basic flow of material is in line, longitudinally, with the axis of the plant.

The 35-S plant consists of a 1036 jaw crusher, a 3024 double-roll crusher, 2½-deck vibrator screen, and the necessary conveyors. Included on the plant is a 30G (30-in.) mechanical feeder, or a 30-in. x 40-ft super heavy service swivel feed conveyor to conveyor on plant, with 30G feeder at lower end. All units are assembled on a welded steel truck frame which in turn is mounted on a rear equalizer and single front dolly with 12 pneumatic tires.

Total weight of the plant varies between 56,350 and 58,550 lb, depending on whether bolster with wheels, or semi-trailer hitch is used on front end. Travel length of the plant (with delivery conveyor folded) is approximately 39 ft, and travel width is 8 ft 10 in. Travel height is 12 ft 6 in.—Pioneer Engineering Works, 1515 Central Ave., Minneapolis 13, Minn.

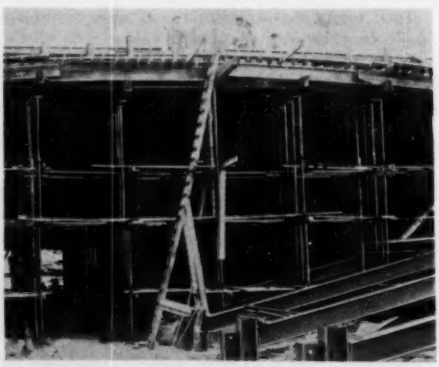


Bulk material handling

Vacu-Blast Co., Inc., has released Bulletin No. 55 describing their pneumatic conveyor, called Vacuveyor. The Vacuveyor is said to be particularly applicable to conveying operations involving dry, powdered, or granular material. One application is the unloading of bulk railroad cars and trucks.—Vacu-Blast Co., Inc., P. O. Box 855-R, Belmont, Calif.

Concrete block handling

William Brothers Boiler and Manufacturing Co. has announced development of a Lectro-Lift material handling truck body for concrete block. The Lectro-Lift is said to unload block three times faster than a two-man crew working manually. One man handles the entire operation, and block may be loaded directly from stockpiles. The manufacturer claims block can be unloaded into excavations 8 ft below ground level and a Lectro-Lift bed carrying 432 8-in. block can be unloaded in eight minutes. The unit is powered by a three-phase generator operated by a twin-cylinder air-cooled engine. Four models are available in bed lengths of 12, 14, 16, and 18 ft.—William Brothers Boiler and Manufacturing Co., Minneapolis 14, Minn.



Bridge underpinning

An unusual use was found for Acrow steel shores as underpinning on bridge false work on the Sullivan Square Overpass job, Boston, Mass. The shores were double-decked to heights ranging from 16 to 26 ft, with a 3 x 8-in. plank between them. Five tons of concrete were placed in the deck supported by the shores at each lift.—Acrow, Inc., 510 N. Dearborn St., Chicago 10, Ill.

Portable heaters

The Bica Co. announces the addition of several new models to its line of Sonic-Ray portable space heaters. The new models are the Model "T," Model "W," and three AGA (American Gas Assn.) approved Sonic-Ray space heaters.

The Model "T" is rated at 85,000 Btu and is thermostatically controlled with an automatic safety shut-off. It is designed for safe unattended operation, with a self-contained thermostat for maintaining predetermined room temperatures.

The Model "W" is a portable, combination water and space heater. It is rated at 85,000 Btu input with a capacity of 100 gal. per hr at 125 F.

The AGA approved, Models "AD," "AF," and "AT" are rated at 50,000 Btu input and may be used for permanent or semi-permanent installations.—Bica Co., 1170 N. State St., Girard, Ohio

Canadian conference on prestressed concrete

A Canadian conference on prestressed concrete will be held in Toronto, Ont., Jan. 28-29, 1954, in Hart House Theatre at the University of Toronto. The conference is intended to be a concise review of prestressed concrete for Canadian engineers, architects and builders. Although at this time, the use of prestressed concrete in Canada is relatively limited, interest is increasing rapidly, as is evidenced by the recent formation of a prestressed concrete development group. All speakers at the conference are acknowledged experts in their particular fields, and it is expected that many problems peculiar to the development of prestressed concrete under Canadian conditions will be discussed.

The conference is sponsored by the Extension Department of the University of Toronto, with support of other interested bodies. The organization of the conference is being carried out by the following committee: chairman, Prof. C. F. Morrison, Department of Civil Engineering, University of Toronto; secretary, H. Fealdman, Structural Research Department, Hydro-Electric Power Commission of Ontario; J. A. Gow, Office of the Secretary, Faculty of Applied Science and Engineering, University of Toronto; Prof. M. W. Huggins, Department of Civil Engineering, University of Toronto; Prof. T. R. Loudon, head of Departments of Civil Engineering and Aeronautical Engineering, University of Toronto; R. H. Macdonald, Steel Co. of Canada; M. MacMurray, representing the Toronto Branch of the Engineering Institute of Canada; E. P. Muntz, consulting engineer, Hydro-Electric Power Commission of Ontario; D. O. Robinson, Canada Cement Co.; and R. B. Young, concrete consultant, Hydro-Electric Power Commission of Ontario.

Membership in the American Concrete Institute

To facilitate prospective members in joining the Institute, membership application forms are provided. Present Members may aid by bringing these forms to the attention of those who may profit from membership advantages. The grades of membership are described overleaf.

All who have an interest in concrete and a desire to improve it through a nonprofit educational service in gathering, correlating, and disseminating information on design, construction, manufacture, use, and maintenance of concrete structures and products are eligible for Institute membership.

There are many opportunities in the Institute for technical committee activity, contributions from your experience in technical papers and the briefer "Letters from Readers" section, and in reviewing technical literature. Thus you can help further ACI's aim "to provide a comradeship in finding the best ways to do concrete work of all kinds and in spreading that knowledge," and at the same time benefit from the experiences of other Members.

(cut here)

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Date_____

Individual Members, North America and U. S. Possessions	**$15.00**
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Of the annual dues, $12.00 is for the JOURNAL of the American Concrete Institute (except that dues for Junior and Student Members apply in full for the JOURNAL).

The undersigned hereby applies for_____**membership**
(Individual, Corporation, Contributing, Junior, Student)

in the American Concrete Institute. Proposed by_____

For Corporation Membership, ACI representative will be_____

_____ _____
(Date of graduation if Student) (Name, if Corporation)

Signature_____

For our records, please complete both sides of application.

EXCERPTS FROM BYLAWS: ARTICLE I—MEMBERS

Section 1. This Institute shall consist of Members, Corporation Members, Contributing Members, Junior Members, Student Members and Honorary Members interested in furthering the Institute's objects as set forth in its Charter.

Sec. 2. A Member shall be an individual.

A Corporation Member shall be a firm, corporation, society, agency of government or other organization. A Corporation Member shall name one individual as its representative who will enjoy all membership rights and privileges.

A Contributing Member shall be an individual, firm, corporation, society, agency of government or other organization wishing to give larger support to Institute activities through the payment of larger dues. Contributing Members, other than individuals, shall name representatives as do Corporation Members.

A Junior Member shall be a person less than 28 years old.

A Student Member shall be less than 28 years old and a student in residence at a recognized technical or engineering school.

An Honorary Member shall be a person of eminence in the field of the Institute's interest, or one who has performed extraordinarily meritorious service to the Institute.

Sec. 3. All classes of Members except Honorary Members and Student Members, shall be proposed by at least one Member of the Institute and elected by a two-thirds vote of the Board of Direction. An Honorary Member shall be elected by unanimous vote of the Board of Direction. A Student Member shall be proposed by a member of his school's faculty, who need not be a Member of the Institute, and elected by a two-thirds vote of the Board of Direction.

Sec. 4. All Members shall have all rights and privileges of membership as determined by the Board of Direction except that a Junior or Student Member shall not vote nor hold office. The status of a Student Member shall change automatically to that of Junior Member on the first anniversay of his membership succeeding the date on which he ceases to be a student in residence. The status of a Junior Member shall be changed to that of Member on the first anniversary of his membership after he becomes 28 years of age.

Sec. 5. Applications for and resignations from Membership and requests for change of representatives of Corporation or Contributing Memberships shall be presented in writing to the Secretary-Treasurer. Resignations may be accepted only from Members whose dues are not more than 60 days in arrears, except by special action of the Board of Direction.

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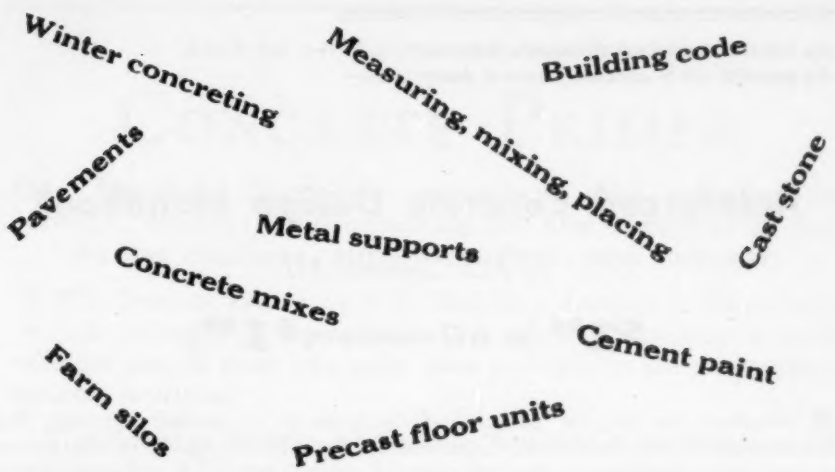

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Effect of Sustained Overload on the Strength and Plastic Flow of Reinforced Concrete Beams—G. W. Washa and P. G. Fluck

Economical Design of Prestressed Concrete Beams—David P. Billington

Discussion closes February 1, 1954

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